



# **Total Station Instruction Manual**

**English Version**

**NERXON GMBH**

Dear Customer:

Congratulations! We, NERXON are proud to present you with an NERXON N02 PLUS instrument. Your total station is a rugged and reliable instrument whose performance and design are not surpassed.

To fully appreciate and protect your investment, we suggest that you take the necessary time to read and fully understand this manual. We have a dedicated service organization. If the need arises, please don't hesitate to call us.

Thank you for your trust and confidence.

## **NOTE:**

### **Don't collimate the sun directly**

Avoid insulating the instrument, and don't collimate the sun directly for protecting eyes and the instrument.

### **Set up the instrument on the tripod**

When using it please ensure the connection between tripod and instrument is firm. It is better to work with a wooden tripod for measurement accuracy.

### **Assemble the tribrach on the instrument**

The setting of the tribrach would influence the accuracy. The tribrach should be checked frequently, the screw which connects the tribrach and alidade must be locked tightly. And the central fixing screw should be tight.

### **Avoiding the vibrations on the instrument**

When transporting, keep the instrument in the case and try your best to lighten vibrations.

### **Carry the instrument**

When carrying, the instrument handle must be held tight.

### **High-temperature condition**

If put the instrument in high-temperature condition for a long time, it is bad for the instrument performance.

### **Temperature changing sharply**

The sharp temperature changing on the instrument or prism will shorten the distance measurement range, for example, after taking the instrument out of a warm car to a cold condition, wait for some time, it can be used when it adapts to the surrounding condition.

### **Check the battery power**

Before using the instrument, make sure you check the power whether it is enough.

### **Taking the battery out**

When the instrument is on it is suggested not to take the battery out, otherwise, the stored data may be lost, so it is better to replace the battery after you turn off the instrument.

### **Stored data responsibility**

NERXON should not be held liable for the lost data because of the wrong operation.



### **The noise from the instrument**

When the instrument is working, it is normal to hear the noise from the instrument motor, it will not affect the instrument work.

## Definitions of Indications

For the safety of your product and prevention of injury to operators and other persons as well as prevention of property damage, items that should be observed are indicated by an exclamation point within a triangle used with WARNING and CAUTION statements in this manual.

The definitions of the indications are listed below. Make sure you understand them before reading the manual's main text.

	<b>WARNING:</b>	Ignoring this indication and making an operation error could result in death or serious injury to the operator.
	<b>CAUTION:</b>	Ignoring this indication and making an operation error could result in personal injury or property damage.

## PRECAUTIONS FOR SAFE OPERATION

### **WARNING**

- Only NERXON authorized distributors can disassemble or rebuild the instrument.
- Do not collimate the sun directly. The eye injury or blindness could result.
- Covering the charger while charging may result in fire.
- If using defected power cable, socket or plug, there is a danger of fire or electronic shock.
- Using a wet battery or charger may result in fire or electronic shock.
- Do not keep the instrument near burning gas or liquid, and do not use the instrument in a coal mine, the blast could happen.
- Do not put the battery in the fire or high-temperature condition. Explosion or damage could result.
- If not using the specified battery or cable by NERXON, there is danger of fire, electric shock or burn.
- If a short circuit of the battery occurred, there is a danger of fire.
- When this product encounters disruption of severe Electrostatic Discharge, perhaps it will have some degradation of performance like switching on/off automatically and so on.



## CAUTION

- Do not touch the instrument with wet hands, there is a danger of electric shock.
- Standing or seating on the carrying case, or turning it over arbitrarily, may damage the instrument.
- Be careful with the tripod feet when setting up or moving it.
- Do not drop the instrument into its case, also check the handle, locks, and hinges before carrying the case, instrument damage could result.
- Do not touch liquid leaking from the instrument or battery. Harmful chemicals could cause burn or blisters.
- Please assemble the tribrach carefully, if the tribrach is not stable, series damage could result.
- In case of dropping the instrument or tripod, serious damage could result. Make sure the central screw is tightened before using it.

## User

1) This product is for professional users only!

The user is required to be a qualified surveyor or have good knowledge of surveying, to understand the user manual and safety instructions, before operating, inspecting or adjusting.

2) Put on the required protectors (safety shoes, helmet, etc.) when operating.

## Exceptions from Responsibility

1) The user of this product is expected to follow all operating instructions and make periodic checks of the product's performance.

2) The manufacturer assumes no responsibility for any direct, indirect, consequential damage, and loss of profits by faulty or intentional usage or misuse.

3) The manufacturer assumes no responsibility for consequential damage, and loss of profits by any disaster, (an earthquake, storms, floods, etc.).

4) The manufacturer assumes no responsibility for any damage, and loss of profits due to a change of data, loss of data, interruption of business, etc., caused by using the product or an unusable product.

5) The manufacturer assumes no responsibility for any damage, and loss of profits caused by usage except for explained in the user manual.

6) The manufacturer assumes no responsibility for damage caused by wrong transport or action due to connecting with other products.

## Safety Standards for Laser

NERXONNT02 PLUS series adopts the safe and visible laser based on the “Specification Standard of radiant products” (FDA CDRH.21CFR Part 1040.10 and 1040.11) and “Safety of laser products – paNT02 1: Equipment classification, requirements and user’s guide” (IEC 60825-1:2001).

According to the above standards, NERXONNT02 PLUS series is class 3R III laser products. When the prism or reflective sheet is selected in Config mode as the target, the output is equivalent to the safer class 1.

Once the instrument is damaged, do not disassemble it. You’d better contact NERXON or local dealer.

## Labels

Follow the safety instructions on the labels as well as in this manual to ensure safe use.



## Note for Safety



### WARNING

- Never point the laser beam at other’s eyes, it could cause serious injury.
- Never look directly into the laser beam source, it could cause permanent eye damage.
- Never stare at the laser beam, it could cause permanent eye damage.
- Never look at the laser beam through a telescope or other optical devices, it could cause permanent eye damage.

# CONTENT

<b>NOTE:</b> .....	2
<b>Definitions of Indications</b> .....	3
<b>PRECAUTIONS FOR SAFE OPERATION</b> .....	3
<b>User</b> .....	4
<b>Exceptions from Responsibility</b> .....	4
<b>1. Introduction</b> .....	5
1.1 Nomenclature .....	5
1.2 Operating the instrument.....	7
1.2.1 Keypad .....	7
1.2.2 Trigger key .....	8
1.2.3 Soft Keys .....	8
1.2.4 Symbols .....	8
1.3 Display .....	9
1.4 Menu Diagram.....	9
1.5 Power On/Off .....	12
1.5.1 Power On.....	12
1.5.2 Power Off .....	12
1.6 How to Configure.....	12
1.6.1 Light .....	13
1.6.2 Contrast .....	13
1.6.3 Reticle Illumination .....	13
1.6.4 Tilt correction .....	13
1.6.5 Laser-Point .....	13
1.7 How to Set Parameters .....	13
<b>2. Preparation before Measurement</b> .....	13
2.1 About Battery .....	13
2.1.1 Battery Power Symbol.....	13
2.1.2 Replace and mount battery .....	14
2.1.3 Recharge battery .....	14
2.2 Setting up the instrument.....	15
2.3 Centering .....	15
2.3.1 Centering with Optical Plummet (Optional) .....	15
2.3.2 Centering with Laser Plummet.....	16
2.4 Levelling-Up .....	17
2.4.1 Basic Levelling-Up with the circular level .....	17
2.4.2 Accurate Levelling-Up with plate level.....	17

2.4.3 Accurate Levelling-Up with Electronic Level on the screen.....	17
2.5 Input mode.....	18
2.5.1 Insert characters.....	18
2.5.2 Delete characters .....	18
2.5.3 Clear characters .....	18
2.5.4 Toggle through characters .....	18
2.6 Measuring.....	19
3 Function key.....	19
4 Programs .....	23
4.1 Application presettings.....	23
4.1.1 Setting job .....	23
4.1.2 Setting Station .....	23
4.1.3 Setting Orientation .....	24
4.2 Applications.....	24
4.2.1 Abstract.....	24
4.2.2 Measuring Duties .....	25
4.2.2.1 Surveying.....	25
4.2.2.2 Stake Out .....	25
4.2.2.3 Free Station.....	27
4.2.2.4 COGO .....	31
4.2.2.5 Tie Distance.....	38
4.2.2.6 Area & Volume.....	40
4.2.2.7 Remote Height.....	42
4.2.2.8 Reference Line/Arc .....	43
4.2.2.9 Construction .....	53
4.2.2.10 Lead Measure .....	54
4.2.2.11 2D-Road .....	62
5 Settings.....	73
5.1 Contrast .....	73
5.2 Trigger key .....	73
5.3 USER Key .....	73
5.4 V-setting .....	73
5.5 Tilt Correction .....	73
5.6 Horizontal Collimation.....	73
5.7 Sector Beep .....	73
5.8 Beep .....	74
5.9 Horizontal Incrementation.....	74
5.10 Reticle Illumination .....	74



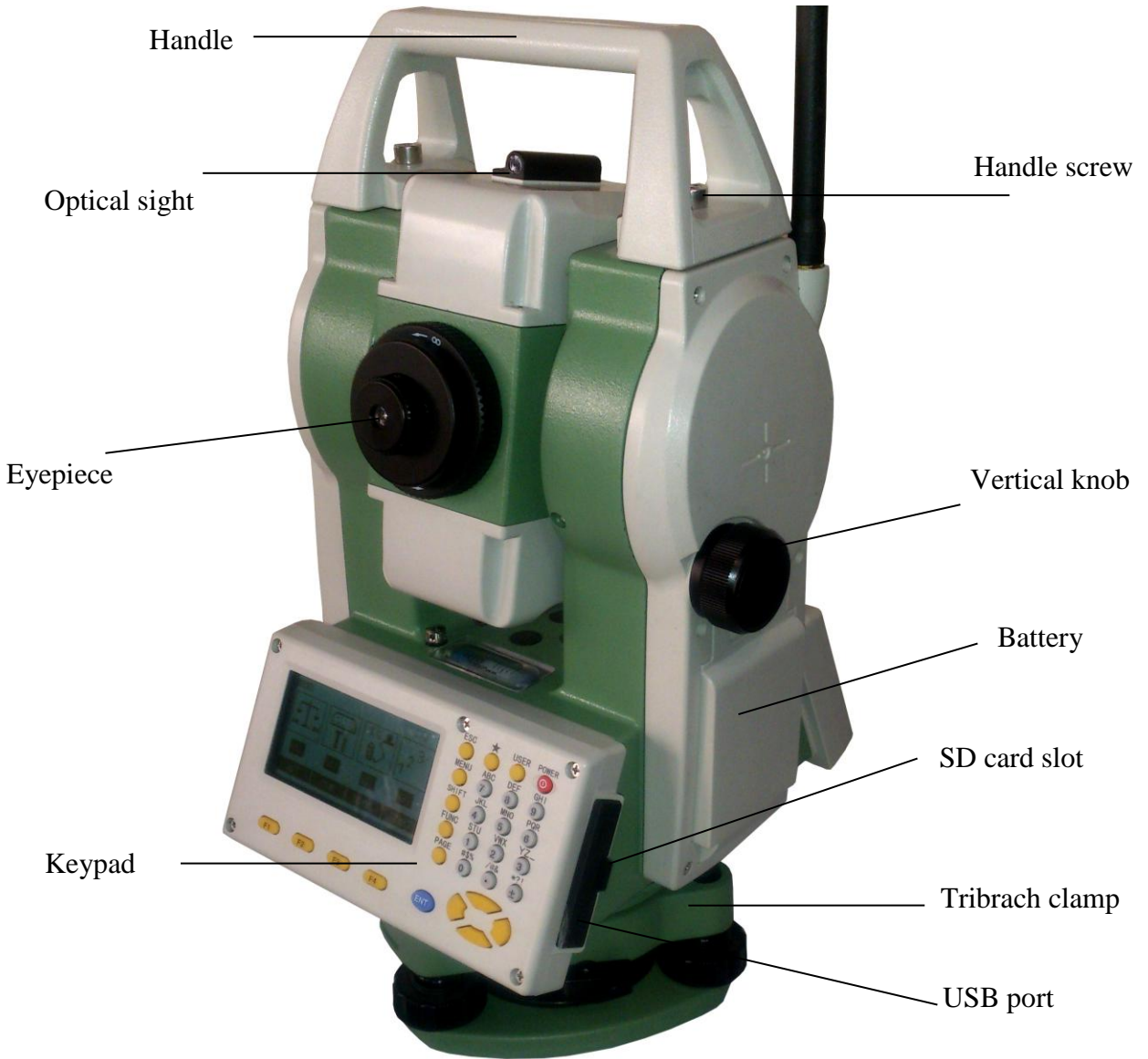
5.11 Auto-TP(Liquid crystal heating) .....	74
5.12 Auto-Off .....	74
5.13 Min. Reading .....	74
5.14 Angle Unit .....	75
5.15 Distance Unit .....	75
5.16 Temperature Unit.....	75
5.17 Pressure Unit .....	75
5.18 Code Record .....	75
5.19 Face I Definition.....	75
5.20 Data Output .....	75
5.21 Coordinate Format.....	76
6 EDM Settings .....	76
6.1 EDM Mode.....	76
6.2 Prism Type.....	76
6.3 Prism Constant .....	77
6.4 Laser Point.....	77
6.5 Guide Light .....	77
7 File Management (JOB).....	79
7.1 Job .....	79
7.2 Fixpoints.....	79
7.3 Measurements.....	80
7.4 Codes.....	80
7.5 Initialize Memory .....	80
7.6 Memory Statistic .....	81
7.7 Memory Select .....	81
7.8 USB .....	82
8 Check and Adjust .....	83
8.1 Horizontal Collimation Error and Vertical Index Error .....	83
8.1.1 Horizontal Collimation Error C.....	83
8.1.2 Vertical Index Error .....	85
8.2 Plate Level and Circular Level.....	86
8.2.1 Plate Level.....	86
8.2.2 Circular Level.....	86
8.3 Optical Plummet and Laser Plummet.....	87
8.3.1 Optical Plummet (factory optional).....	87
8.3.2 Laser Plummet.....	87
8.4 The Optical Sight.....	88
8.5 Vertical Cross-hair on Telescope .....	89

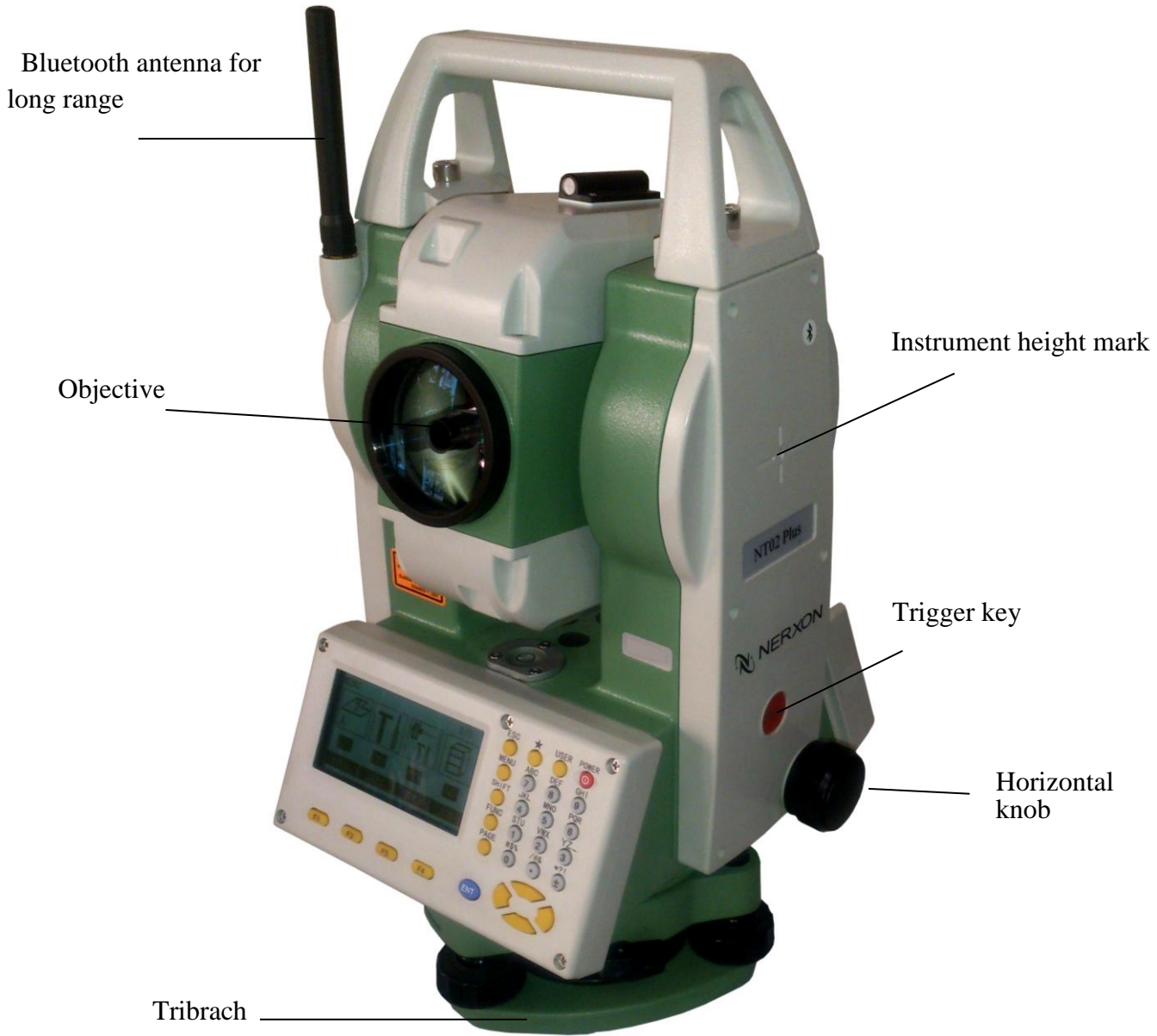
8.6 EDM Optical Axis and the Telescope Sighting Axis Error .....	90
9 Communicate Parameters.....	91
10 Data Transfer.....	92
11 Start-up sequence.....	92
12 System Information .....	93
13 Instrument Maintenance.....	94
13.1 Cleaning and Drying .....	94
13.2 Storage.....	94
13.3 Transportation.....	94
13.4 Check.....	94
14 Specifications .....	95
14 Standard components .....	98
Appendix I: Atmospheric correction formula and chart (Just for reference).....	99
Appendix II: Correction for refraction and earth curvature .....	101
Appendix III: Assembling and disassembling for three-jaw tribrach.....	102

# 1.Introduction

The NERXONNT02 PLUS series is a high-quality electronic Total Station designed for the construction site. Its innovative technology makes daily surveying jobs easier. The instrument is ideally suited for simple construction surveys and stake out tasks. The convenient operation of the instrument functions can be learned in no time.

## 1.1 Nomenclature





## 1.2 Operating the instrument

### 1.2.1 Keypad



Fixed Keys	Name	Functions
F1~F4	Select key	Select the functions matching the soft keys.
0~9/ A~!	Alphanumeric keypad	Enter letters numerical values or other characters.
Shift	Shift key for character entry	1.Shift between number and alphabet when inputting. 2.Shift targets model when measuring.
★	Star key	Essential configurations including illumination, etc can be set here.
User	User key	Key, programmable with function from the Func menu.
Page	Page key	Scroll to the next page when a dialogue consists of several pages.
Menu	Menu key	Access comprehensive menu display including measuring programs, specific settings, the data manager, adjustments, communications parameters, system information, and data transfer.
Enter	Enter key	Confirm an entry or selection.
ESC	Escape key	Quit a screen or edit mode without saving changes.
Func	Function key	Perform sorts of fast function settings defined by program screen.
◀▲▼▶	Navigation key	Control the focus bar within the screen and the entry bar within a field.

①	Power key	Turn on/off the instrument
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### 1.2.2 Trigger key

The measurement trigger key has three settings (ALL, DIST, OFF). The key can be activated in the [SETS] item of configuration menu.



### 1.2.3 Soft Keys

Under soft keys, a selection of commands and functions is listed at the bottom of the screen. They can be activated with the corresponding function keys. The available scope of each function depends on the applications currently active.

General soft keys:

[ALL] Start distance and angle measurements and saves measured values.

[DIST] Start distance and angle measurements without saving measured values.

[REC] Save displayed values.

[ENT] Delete current value in the display and is ready for the input of a new value.

[ENH] Open the coordinate input mode.

[LIST] Display the list of available points.

[FIND] Start the search for the point entered.

[EDM] Display EDM settings.

[PREV] Return last active dialog.

[NEXT] Continue to next dialog. Returns to highest soft key level. To next soft key level.



[OK] Set displayed message or dialog and quit dialog.



[SHIFT=0] Set the value to zero.



[STOP] Stop procedure being carried out.

### 1.2.4 Symbols

Depending on software version different symbols are displayed indicating a particular operating status.

- 1)  A double arrow indicates a field has a selectable list.
- 2) **I, II** Indicates telescope position I or II.
- 3)  The battery symbol indicates the level of the remaining battery capacity (75% full shown in the example).
- 4)
 

	Compensator is on.
	Compensator is off.
- 5)
 

	Keypad is set to numeric mode.
	Keypad is set to alphanumeric mode.

### 1.3 Display

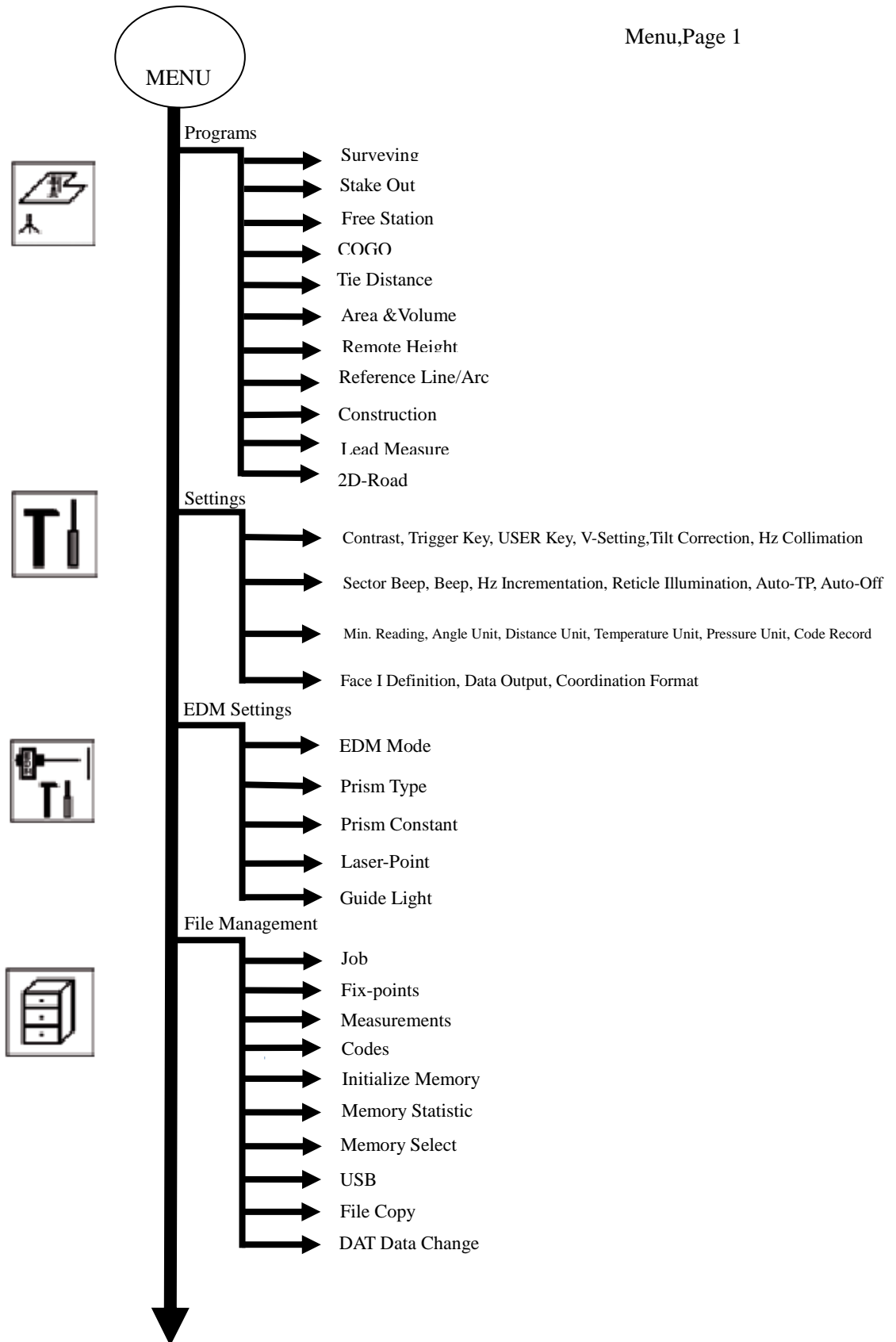
NERXONNT02 PLUS series is equipped with two large LCD screens(240×128dots). The LCD could display 8 lines with 24 characters per line.

**Note: Do not touch the screen with sharp things.**

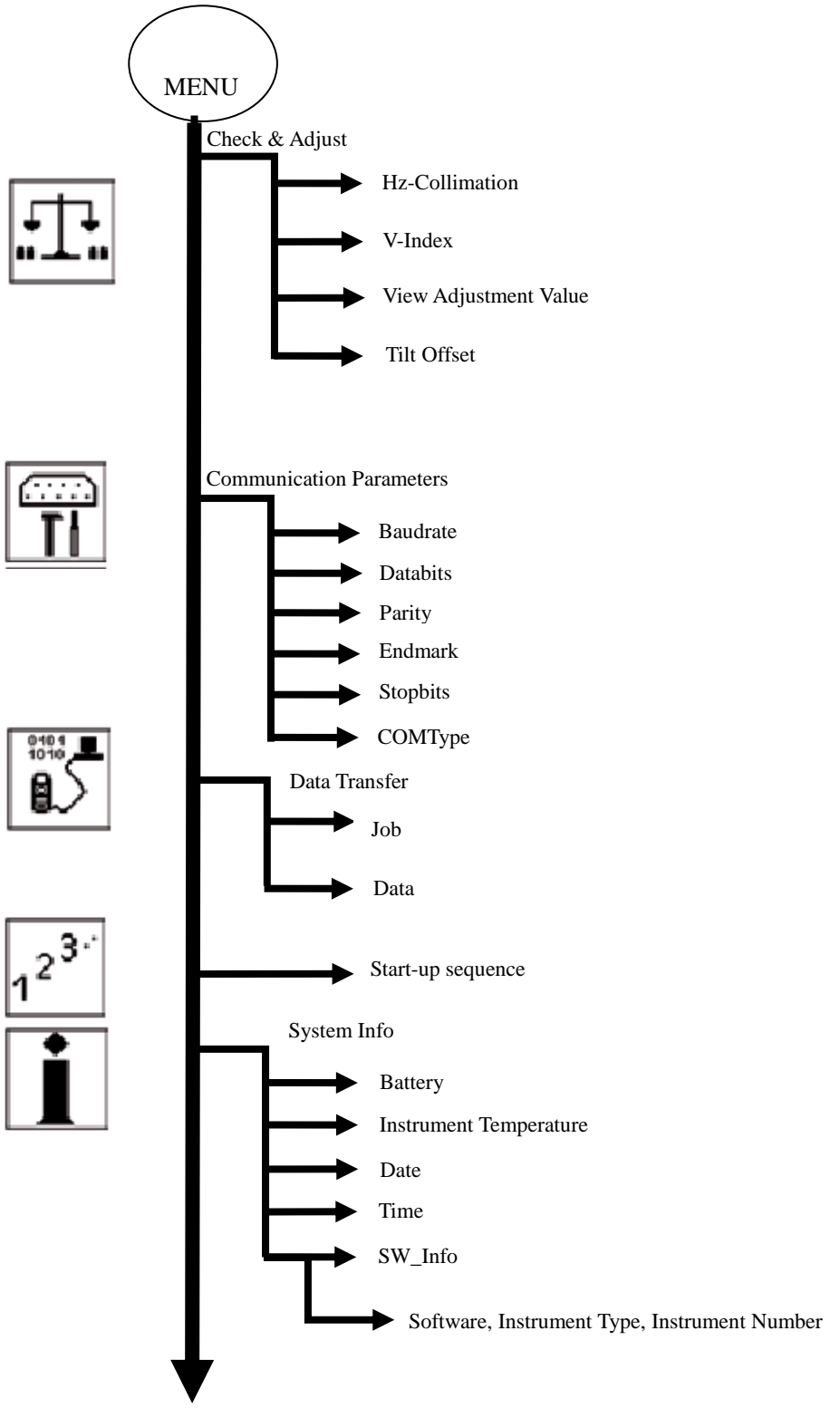
### 1.4 Menu Diagram

[MENU]→F1-F4: Confirm menu selection

[PAGE]→Scroll to next page





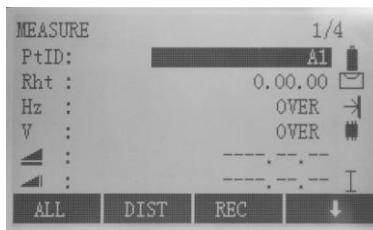


## 1.5 Power On/Off

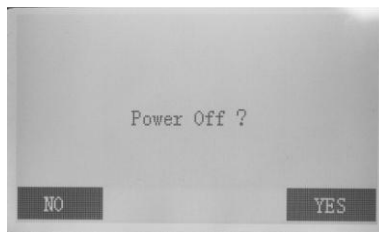


### 1.5.1 Power On

- 1) Confirm the instrument is leveling, then press the red key [Power] and it will be turned on in no time.
- 2) The instrument will display the status screen.



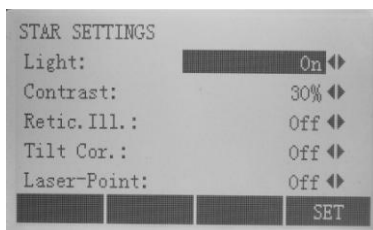
### 1.5.2 Power Off



Press the [Power] key again and the screen will remind whether to power off.

## 1.6 How to Configure

Press key [★] on the panel to access star settings mode, and do some basic essential settings. Change settings if necessary. Use up and down direction keys to select items and utilize left and right direction keys to set the options.



### 1.6.1 Light

Press left or right direction keys to turn on or off the backlight.

### 1.6.2 Contrast

Press left or right direction keys to adjust it. There are ten levels (10%-100%) which can be set.

### 1.6.3 Reticle Illumination

Press left or right direction keys to adjust it (on or off).

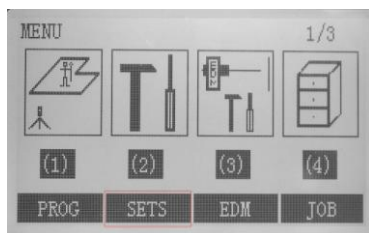
### 1.6.4 Tilt correction

Press left or right direction keys to adjust it. And it gives the possibility to choose among three options (1-axis,2-axis and off).

### 1.6.5 Laser-Point

Press left or right direction keys to turn on or off laser beam.

## 1.7 How to Set Parameters

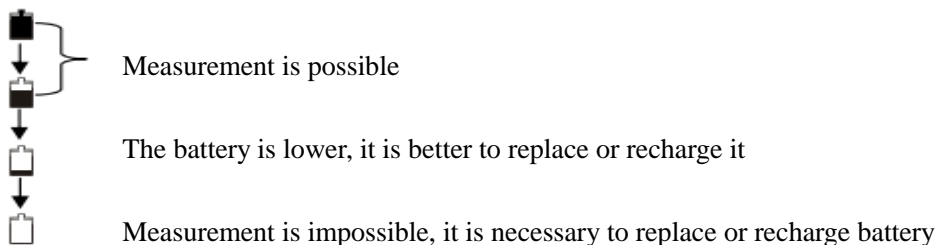


Press key [MENU] on panel to enter into comprehensive menu mode, then select [SETS] item, where relevant parameters can be set. Detailed operation can be referred to settings in chapter 4.2.

## 2. Preparation before Measurement

### 2.1 About Battery

#### 2.1.1 Battery Power Symbol



#### Note:

1)The battery's working time will be affected by many factors, such as ambient temperature, recharging time, recharging and discharging times. So we suggest the users recharge the battery full or prepare several full batteries before operation.

2)The battery symbol only indicates power capability for current measurement mode. The

power consumption in distance measurement mode is more than in angle mode, if the instrument enters into distance measurement mode from angle mode, the power maybe auto-off because of lower battery.

3)The symbol only indicates the supply power but not the instantaneous power change. And if the measurement mode changes, the symbol will not show the power's decrease or increase immediately.

4)It is suggested that user should check every battery power before field work.



### 2.1.2 Replace and mount battery

1) Replace battery

- ① Press the button downward as shown left.
- ② Remove the battery by pulling it toward you.

2) Mount battery

- ① Insert the battery to the instrument.
- ② Press the top of the battery until you hear a click.

### 2.1.3 Recharge battery

1)Connect the charger connector to the battery.

2)Plug the charger on 100V/240 power supply. The red lamp becomes lighting, which indicates recharging. If interval-time is longer, the connector isn't fixed well.

3) That the green lamp flashes means recharging is complete.

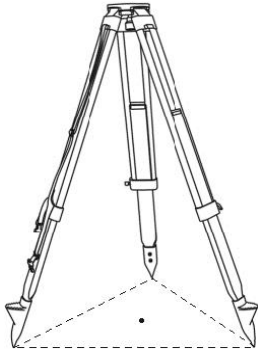


### Note:

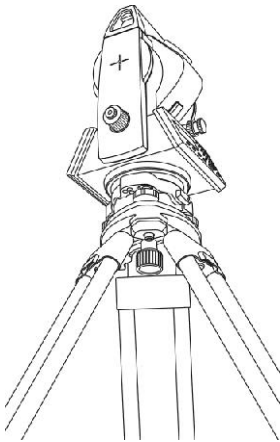
1 New battery (or battery does not used for several months) should be recharged for several times. Please recharge it more than 10 hours, and then the battery can attain best status.

2 Please recharge the battery continuously for another 1~2 hours after the light green, which is good for the battery.

## 2.2 Setting up the instrument



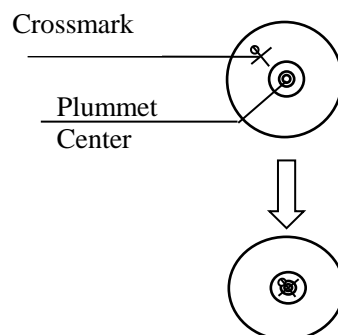
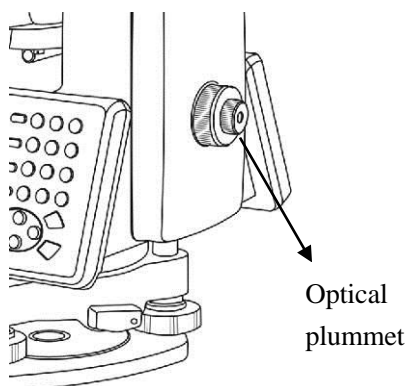
1) Set up the tripod first: Extend the extension legs to suitable lengths and tighten the screws on the legs. Make sure the legs are spaced at equal intervals and the head is approximately level. Set the tripod so that the head is positioned over the surveying point. Make sure the tripod shoes are firmly fixed in the ground.



2) Attaching the instrument on the tripod head: Mount the instrument carefully on the tripod head. Supporting it with one hand, tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.

## 2.3 Centering

### 2.3.1 Centering with Optical Plummet (Optional)



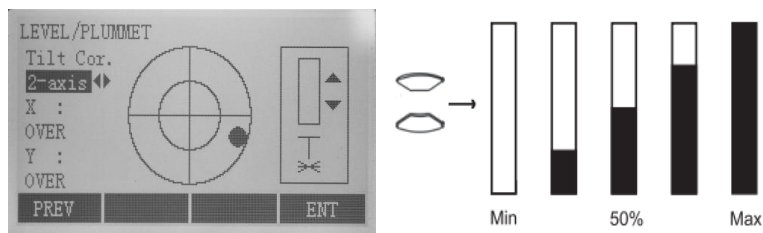
Turn the focusing ring of the optical plummet to focus the ground mark point. Then adjust three foot-screws to center the bubble of the circular level. If the plate level is not leveling-up, you can loosen the center screw of the tripod, and move the instrument to

center the bubble of the plate level. At last tighten the center screw. Repeat above steps until the center of reticule always coincides with the mark point when rotating alidade of instrument.

**Note:** Use the three leveling screws and tripod to center the instrument.

### 2.3.2 Centering with Laser Plummet

External influences and the surface conditions may lead to the requirement of the adjustment of the laser intensity. The laser can be adjusted in 25% steps as required. If the instrument is equipped with laser plummet, after activating electronic level, the laser plummet adjusting bar will display. With pressing up or down keys the laser lightness can be adjusted.

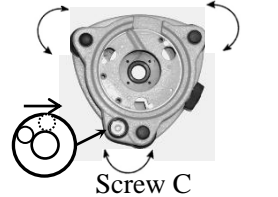
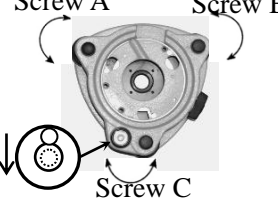


Operation Steps:

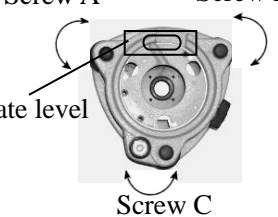
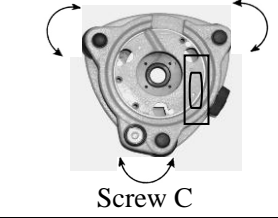
- 1) Press the "Func" key, and then click "F1" to enter into the display as shown in the upper figure. With pressing up or down direction keys you can turn on or off laser plummet and set it as four levels of brightness. Thus, that laser emits downwards can be seen.
- 2) Loosen the center screw of tripod, and move the base plate on tripod head until the laser spot coincides with ground mark point. Then tighten the center screw.
- 3) Repeat leveling and two steps until the instrument keeps leveling and the laser spot coincides with ground mark point when rotating alidade of instrument in any direction.
- 4) After centering, please turn off laser plummet to save power.

## 2.4 Levelling-Up

### 2.4.1 Basic Levelling-Up with the circular level

	<p>1. Move the foot screws A and B in opposite direction till the circular bubble is perpendicular to a line shaped with screw A and B. The direction of rotation in left thumb indicates the movement of the circular bubble.</p>
	<p>2. Move the bubble to the center of the circle by turning screw C.</p>

### 2.4.2 Accurate Levelling-Up with plate level

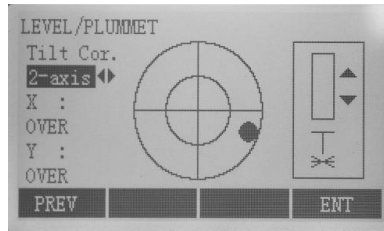
	<p>1. Loosen the horizontal motion clamp, and turn the instrument till the plate level is parallel to a line shaped with screws A and B. Adjust the screws A and B to make the bubble in the center of the level.</p>
	<p>2. Loosen the horizontal motion clamp, and turn the instrument approximately 90°. Adjust the screw C until the bubble in the center of the level.</p>
<p>3. Repeat above steps until the bubble remains in the center of the plate level while the instrument is rotated to any position.</p>	

### 2.4.3 Accurate Levelling-Up with Electronic Level on the screen

It is convenient for NERXONNT02 PLUS series to level-up with electronic level, especially when it is difficult to observe the circular level and plate level.

1) Firstly, power on the instrument, press “Func” button, and then select F1(Level/Plummet). The electronic level displays on screen.

2) Secondly, level it by turning three foot screws and ensure the bubble is in the plate level. Make sure the black spot is in the center.



**Note:** On this menu you can turn on/off the X/Y compensator by pressing left or right direction key.

## 2.5 Input mode

Due to the alphanumeric keypad you can enter characters directly.

1) Numeric fields: Can only contain numerical values. By pressing a button of the numeric keypad the number will be displayed.

2) Alphanumeric fields: Can contain numbers and letters. By pressing a button of the alphanumeric keypad the input opens. By pressing several times you can toggle through the characters. For example: 7->A->B->C->7->A....

### 2.5.1 Insert characters

If a character was skipped (e.g.13 instead of 123), you can insert it later.

Place cursor on "1" → Insert an empty character on the right of "1"(Press F1 key) →

Input the new character "2" → Confirm input.

### 2.5.2 Delete characters

Place cursor on character to be deleted → Delete this character (Press F2 key) →

Confirm delete.

### 2.5.3 Clear characters

Place cursor on any position among character fields → Clear characters (Press F3 key) → Confirm Clear.

### 2.5.4 Toggle through characters

By pressing a button of the alphanumeric keypad the input opens. By pressing F4 key you can switch between numbers and letters. Here at entry status pressing F4 is equivalent to pressing shift key.

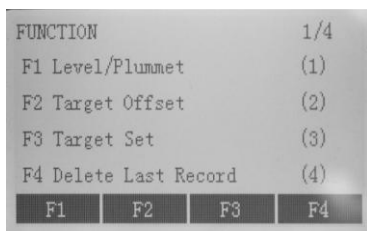


## 2.6 Measuring



After switching on and setting up correctly, the Total Station is immediately ready for measuring. On the measurement display it is possible to call up fixed keys and function keys, as well as trigger keys and their functions.

## 3 Function key



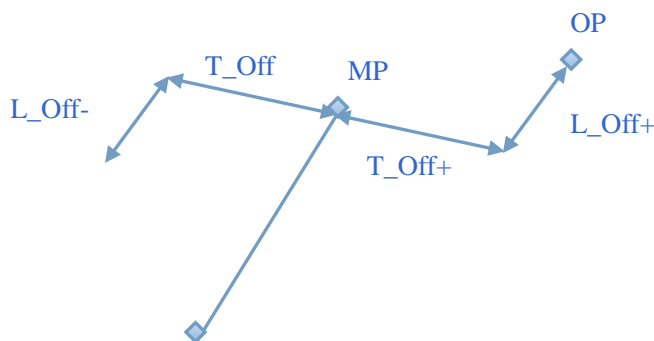
Under “FUNC” menu several functions can be activated. Functions can also be started directly from the different applications. Each function from the FUNC menu can be assigned to the “USER” key. The detailed applications are described below.

### 1) Level/Plummet

This function triggers the electronic bubble and enables the settings of intensity for the laser plummet.

### 2) Target Offset

If it is not possible to set up the reflector directly, or it is not possible to aim at the target point directly, the offset values (length, cross and/or height offset) can be entered. The values for the angle and distances are calculated directly for the target point.



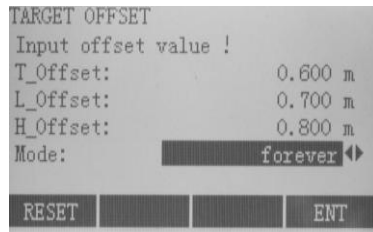
MP: Measurement point

OP: Offset point

T\_Off: Length offset

L\_Off: Cross offset

H\_Offset +: Offset point is higher than measurement



Procedure:

1. Input the offset values (length, cross and/or height) according to the sketch.
2. Define the period during which the offset is to apply. Two modes are available: Reset and Forever. Reset: The offset values are reset to 0 after the point is saved. Forever: The offset values are applied to all further measurements.
3. [RESET]: Sets eccentricity to zero.
4. [ENT]: Calculate the corrected values and jump to the application from which the offset function was started. The corrected angle and distances are displayed once a valid distance measurement has been triggered.

### 3) Target Set

Change among three types (Prism, Sheet and NoPrism).

Prism: Distance measurements with prisms.

Sheet: Distance measurements with sheets.

NoPrism: Distance measurements without prisms.

**Note:** After type selection, press “F4” to return previous page and simultaneously save setting result.

### 4) Delete Last Record

This function deletes the last recorded data block. This can be either a measurement block or a code block.

**Note:** Deleting the last record is not reversible!

Only records can be deleted which were recorded in "Surveying" or in "Measuring".

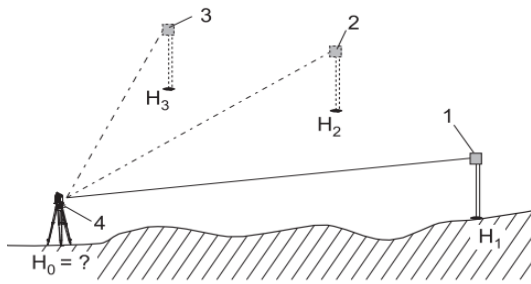
FUNCTION	2/4
F1 Height Transfer	(5)
F2 Hidden Point	(6)
F3 Free-Coding	(7)
F4 Laser Pointer	(8)
F1	F2
F3	F4

### 5) Height Transfer

This function determines the height of the instrument from measurements to a maximum of 5 target points, with known heights, in two faces. With measurements to several targets, the improvement is indicated in the "delta" value.

Procedure:

- ① Select known point and input reflector height.
- ② After triggering the measurement with [ALL], the calculated height “H0” is displayed.



[ADDP] Add another height of a known point.

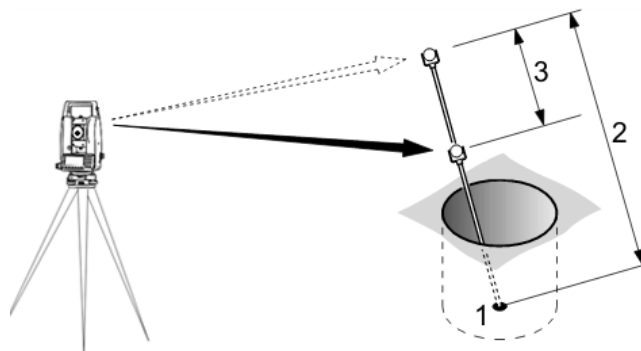
[FACE II ] Measure the same target in the second face.

③ [SET] Save the changes and set the station.

- 1) Reflector 1
- 2) Reflector 2
- 3) Reflector 3
- 4) Instrument

### 6) Hidden Point

The program allows measuring a point that is not directly visible, using a special hidden point rod.



- 1.E, N, H of Hidden Point
- 2.Rod Length
- 3.Distance R1-R2

Procedure:

① Measure the first prism (P1).

[All] Start measuring and proceed to procedure 2.

[ROD/ED] Allow you to define the rod and the EDM-Settings.

**EDM Mode:** Change the EDM Mode.

**Prism Type:** Change the prism type.

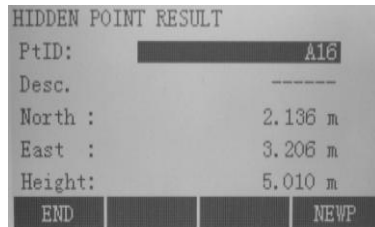
**Prism Const:** Display the prism constant.

**Rod Length:** Total length of hidden-point rod.

**Dist. R1-R2:** Spacing between the centers of reflector R1 and prism R2.

**Meas.Tol:** Limit for the difference between the given and measured spacing of the reflectors. If the tolerance value is exceeded, the program will eject a warning.

- ② [All] Start measuring and proceed to the result.
- ③ Result is displayed.



[END] Return calling application.

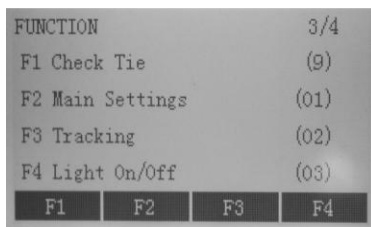
[NEWP] Return procedure 1.

### 7) Free-Coding

Select code from the codelist or enter a new code.

### 8) Laser Pointer

Switch on or off the visible laser beam for illuminating the target point. The new settings are displayed for about one second and then saved.



### 9) Check Tie

Calculation and display of the slope and horizontal distance, height difference, azimuth, grade, and coordinate differences between the last two measured points. Valid distance measurements are required for the calculation. If there exist less than 2 valid

measurements, the values can't be calculated.

### 10) Main Settings

Enable you to change the most important settings which all exist in [SETS] under [MENU].

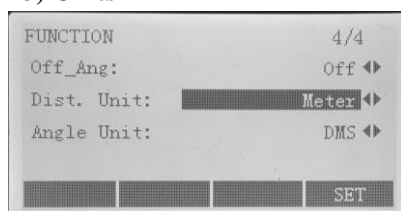
### 11) Tracking

Switch on or off the tracking measurement mode. The new setting is displayed for approximately one second and then set. The function can only be activated from within the same EDM mode and prism type. The last active measurement mode remains set when the instrument is switched off.

### 12) Light On/Off

Turn on or off display illumination.

### 13) Units

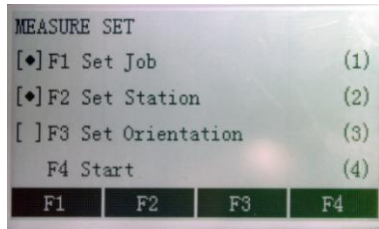


It displays the current distance and angle units and gives the possibility to change them by left or right direction keys.

## 4 Programs

### 4.1 Application presets

These are programs that precede the application programs and are used to set up and organize data collection. They are displayed after selecting an application. The user can select the start programs individually.



[•] Settings made.

[ ] Settings not made.

#### 4.1.1 Setting job

All data is saved in JOBS like directories. Jobs contain measurement data of different types (e.g. fixed points, measurements, codes, stations,..) and are individually manageable and can be readout, edited or deleted separately.

Procedure:

1)Creating a new job. Press [F1], then select [add] key to access the “NEW JOB” screen. Then name the job, record the operator, and make notes.

2)After setting the job, back to start-up programs.

**Note:** All recorded data is stored in this job. Besides, if no job was defined and an application was started or if [ALL] key was triggered, the system would automatically create a new job and name it “DEFAULT”.

#### 4.1.2 Setting Station

Each coordinate computation relates to the set station. At least plan coordinates (E, N) are required for the station. The station height can be entered if required. The coordinates can be entered either manually or read from the internal memory.

Press [F2], namely set station. Afterwards choose either of the two following methods to complete the application of setting station.

##### 1) Set manually

① Select [ENH] to call up manual coordinate input dialogue.

② Input PtID and coordinates (North, East and H).

③ Choose [ENT] to Save station coordinates, the input of the instrument height continued.

④ Choose [ENT] to finish station setting.

## 2) Known Point

① Press [FIND] or [LIST] to select a PtID stored in internal memory.

② Input instrument height.

③ Choose [ENT] to finish station setting.

### 4.1.3 Setting Orientation

With the orientation, Horizontal direction can be input manually or points with known coordinates can be set.

#### 1) Manual Input

① Choose [F1] to access Manual Input screen. Here need to input Backsight PointID, Reflector height and Hz-direction(Azimuth).

② Press [ALL] to start trigger measurement, data saved and orientation set.

#### 2) With Coordinates

Choose [F2] to access Coordinate Orientation screen. There are two methods for orientating with coordinates. Orientation coordinates can be either obtained from the internal memory or entered manually.

① Input the orientation point number and determine the point found before. To determine the orientation, a target with known coordinates can be used. Thus press [LIST] to read out PtID stored in internal memory.

② Press [ENH] to input backsight PointID and coordinate, after confirming this input continue entering reflector height and meantime sighting the target. At last press [ALL] to start trigger measurement, data saved and orientation set.

**Note:** To determine the orientation precisely a maximum of 5 target points with known coordinates can be used for checking.

## 4.2 Applications

### 4.2.1 Abstract

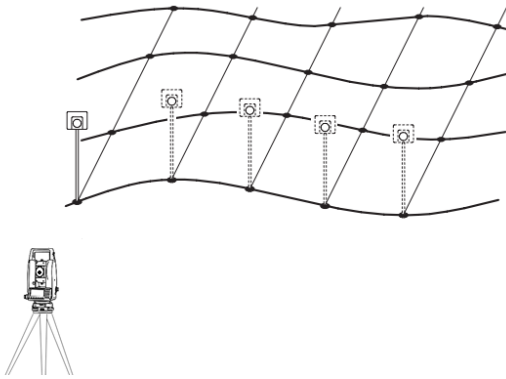
Applications are predefined programs that cover a wide spectrum of surveying duties and facilitate daily work in the field. How to access: Press [MENU] fixed key. —→ Selecting the "Program" option. —→ Press F1-F4 to call up applications and activate start programs. —→ Press [PAGE] fixed key to scroll to next page.

The following applications are available:

- 1) Surveying
- 2) Stake Out
- 3) Free Station
- 4) COGO
- 5) Tie Distance
- 6) Area & Volume

- 7) Remote Height
- 8) Reference Line/Arc
- 9) Construction
- 10) Lead Measure
- 11) 2D-Road

#### 4.2.2 Measuring Duties



##### 4.2.2.1 Surveying

With this program the measurement of an unlimited number of points is supported.

It is comparable to “Meas & Rec”, but includes stationing, orientation and coding.

Procedure:

- ① Input PtID, codes and reflector

height if demanded.

- ② [ALL] Trigger and record measurements.

[IndivPt] Switch between individual and current point number.

Three coding methods are available:

- ① Simple coding:

Input a code into the relevant box. The code is stored along with the corresponding measurement.

- ② Expanded coding:

Press the [CODE] soft key. The code that was input can be searched for within the codelist and it gives the possibility to add attributes to the code.

- ③ Quick coding:

Press the [Q-Code] soft key and enter the shortcut to the code. The code is selected and the measurement staNT02.

##### 4.2.2.2 Stake Out

This program calculates the required elements to stake out points from coordinates or manually entered angles, horizontal distances and heights. Stake out differences can be displayed continuously.

**Stake out coordinates from memory.**

Procedure:

◀▶ Select the point.

[DIST] Start measuring and calculation of the stake-out elements.

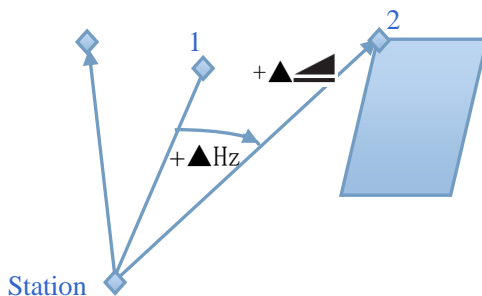
[REC] Save the displayed values.

[B&D] Input direction and Hz-distance of stake out point.

[MANUAL] Enable simplified input of a point without PtID and without the possibility of storing the data of the point.

### ① Polar Stake out

Normal indication of polar stake out offsets.



a) Actual

b) Point to stake out

▲Hz: Angle offset: positive if point to stake out is to the right of the actual direction.

▲: Longitudinal offset: Positive if point to stake out is further away.

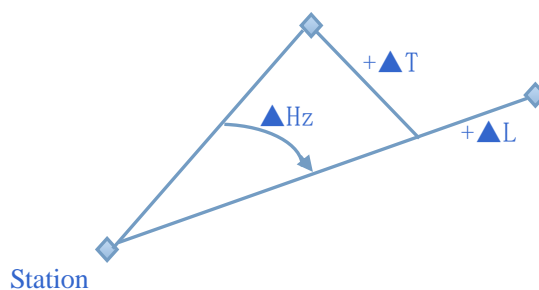
▲: Height offset: Positive if point to stake out is higher than measured point.

### ② Orthogonal Stake out

The position offset between measured point and stake out point is indicated in a longitudinal and transversal element.

a) Actual

b) Point to stake out



▲L: Longitudinal offset: Positive if nominal point is further away.



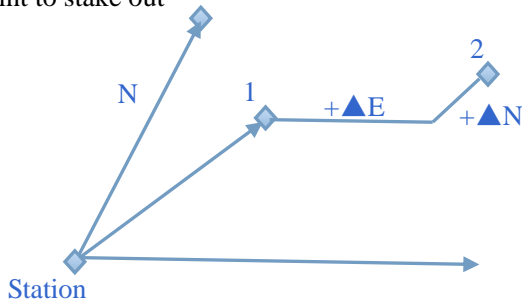
▲T: Transversal offset, perpendicular to line-of-sight: Positive if nominal point is to the right of measured point.

### ③ Cartesian Stake out

Stake out is based on a coordinate system and the offset is divided into a north and east element.

a) Actual

b) Point to stake out

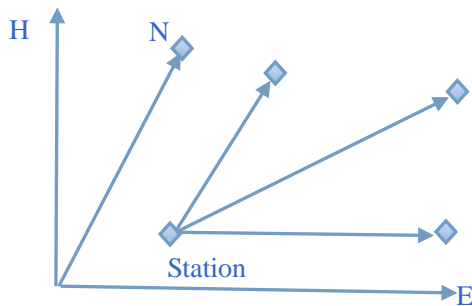


▲E: Easting offset between stake out and actual point.

▲N: Northing offset between stake out and actual point.

#### 4.2.2.3 Free Station

The application is used to determine the instrument position from measurements to a minimum of two known points and a maximum of five known points.



The following measurements sequences to target points are possible:

- Horizontal and Vertical angles only (resection)
- Distances and Horizontal and Vertical angles (3 points resection)
- Horizontal and Vertical angles to some point(s) and Horizontal and Vertical angles plus distances to other point(s).

The final computed results are Easting, Northing and Height of the present instrument station, including the instruments Horizontal Circle Orientation. Standard deviations and

residuals for accuracy assessments are provided.

① Measuring facilities

Single face I or II or dual face I + II measurements are always possible. No specific point sequence or specific face sequences are required. Gross errors checks are made for dual face measurements to ensure the same point(s) are sighted with the other face.

**Note:** If a target point is measured several times in the same telescope position the last valid measurement is used for computation.

**Measurement Disciplines:**

**•2 face measurements**

When measuring the same target in both faces, the reflector height mustn't be changed when changing the telescope position.

**•Target points with 0.000 height**

Target points with 0.000 height are discarded for height processing. If target points have a valid height of 0.000 m, use 0.001 m to enable it for height processing.

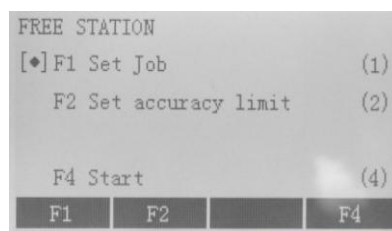
② Computation procedure

The measuring procedure automatically determines the method of evaluation, e.g. resection, 3 point resection, etc. If more than the minimum required measurements are performed, the processing routine uses a least squares adjustment to determine the plane position and averages orientation and heights.

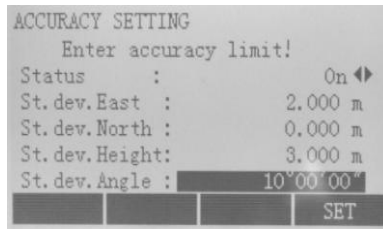
- a)The original averaged measurements of face I and face II are called into the computation process.
- b)All measurements are treated with the same accuracy, whether these are measured in single or dual face.
- c)Easting and northing is determined by the method of least squares, including standard deviation and improvements for horizontal direction and horizontal distances.
- d)The final height (H) is computed from averaged height differences based on the original measurements.
- e)The horizontal circle orientation is computed with the original averaged measurements of face I and face II and the final computed plane position.

Procedure:

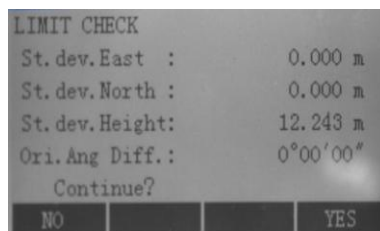
- a)Set job



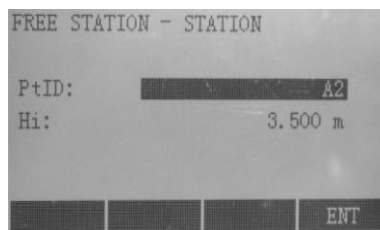
b)Set accuracy limit:



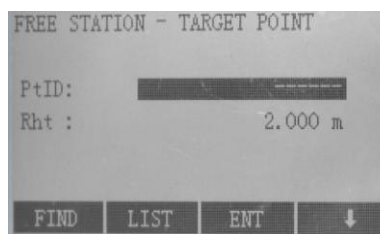
Here you can define a limit for the standard deviation values. If the calculated deviation exceeds the limit, a warning dialog box ejects, which reminds you whether to proceed or not.



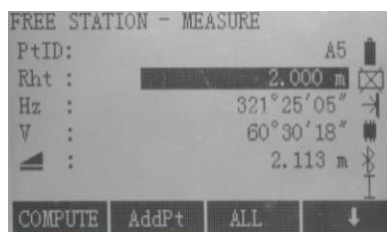
c)Input of the name of the station and the height of the instrument.



d)Input of the target PtID and the reflector height.



e)Measure



[ALL]: Trigger angle and distance measurements (3 point resection).

[REC]: Save horizontal direction and vertical angle(resection).

[AddPt]: Input another backsight point.

[COMPUTE]: I'll calculate and display the station coordinates, if at least 2 points and a distance are measured.

### ③Results

#### Calculated station coordinates displays:

STATION COORDINATE	
Station:	A1
Hi:	3.000 m
North :	-18.258 m
East :	15.345 m
Height:	5.374 m
PREV	RESID
STDEV	ENT

[PREV]: Return previous page.

[RESID]: Display residuals.

[STDEV]: Display standard deviation.

[ENT]: Set the displayed coordinates and instrument height as new station.

**Note:** If the instrument height was set to 0.000 in the setup screen, then the station height refers to height of trunnion axis.

#### Standard deviation displays:

STATION STANDARD DEVIATION	
St.dev.East :	0.000 m
St.dev.North :	0.000 m
St.dev.Height:	2.505 m
Ori.Ang Diff.:	0°00'00"
PREV	ENT

**St.dev.East, North, Height:** Standard deviation of the station coordinates.

**Ori.Ang Diff.:** Standard deviation of the orientation.

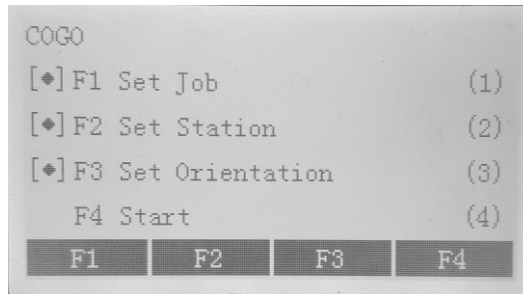
#### The computed residuals displays:

Residual = Calculated value - Measured value

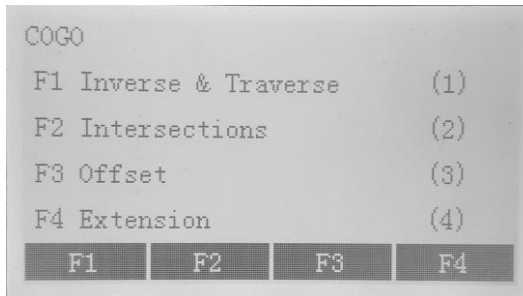
TARGET POINT CORRECTION DATA	
PtID:	2
dHz :	0°00'00"
dHD :	23.526 m
dVD :	-2.355 m
PREV	ENT

◀▶: With the function key, scroll between the residuals of the individual backsight points.

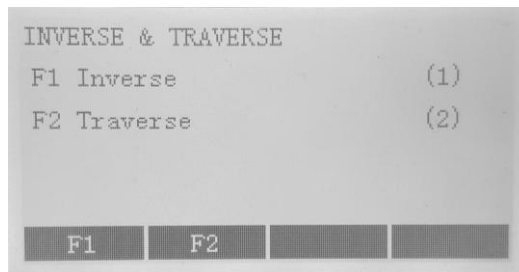
#### 4.2.2.4 COGO



The application is used to perform coordinate geometry calculations such as, coordinates of points, bearings between points and distances between points. The COGO calculation methods are:

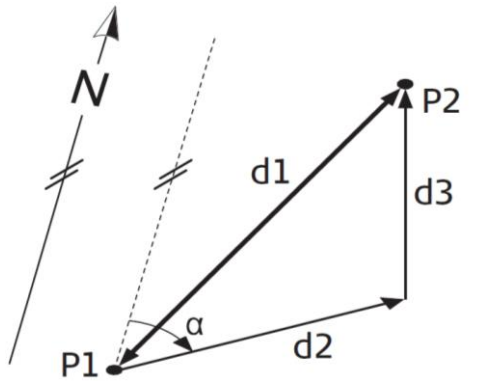
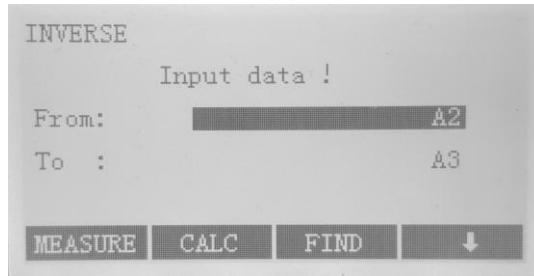


##### 1. Inverse & Traverse



Inverse:

Use the inverse subapplication to calculate the distance, direction, height difference and grade between two known points.



**Known**

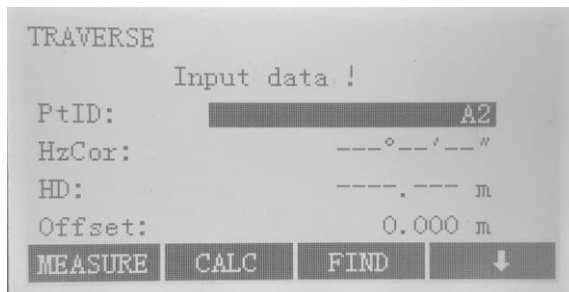
- P1 First known point
- P2 Second known point

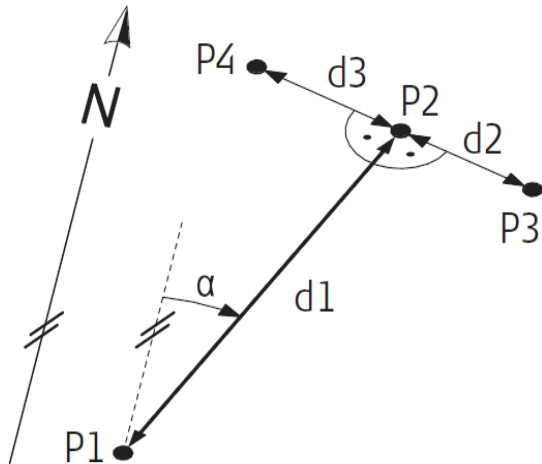
**Unknown**

- $\alpha$  Direction from P1 to P2
- d1 Slope distance between P1 and P2
- d2 Horizontal distance between P1 and P2
- d3 Height difference between P1 and P2

**Traverse:**

Use the traverse subapplication to calculate the position of a new point using the bearing and the distance from a known point. Offset optional.





**Known**

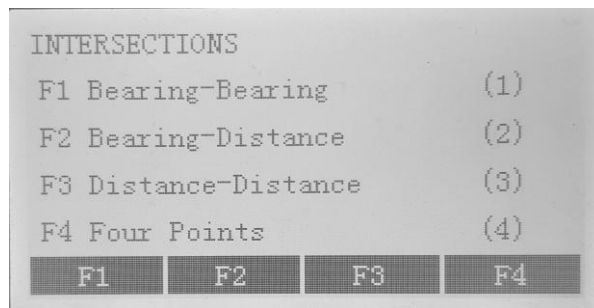
- P1 Known point
- $\alpha$  Direction from P1 to P2
- d1 Distance between P1 and P2
- d2 Positive offset to the right
- d3 Negative offset to the left

**Unknown**

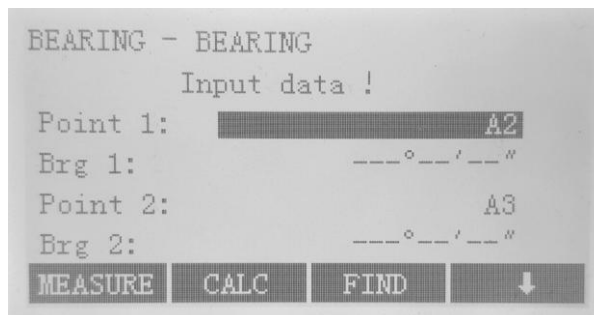
- P2 COGO point without offset
- P3 COGO point with positive offset
- P4 COGO point with negative offset

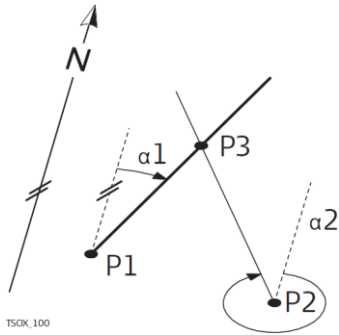
**2. Intersections**

Select Intersection from the COGO MAIN MENU choose either of the four following methods to complete the application of Intersections:



- **Bearing-Bearing:** Use the bearing-bearing subapplication to calculate the intersection point of two lines. A line is defined by a point and a direction.





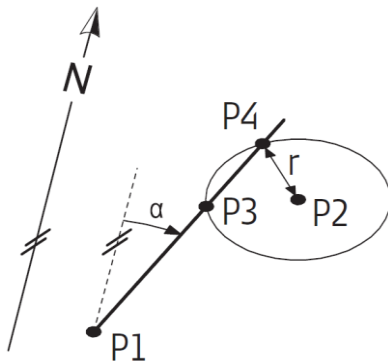
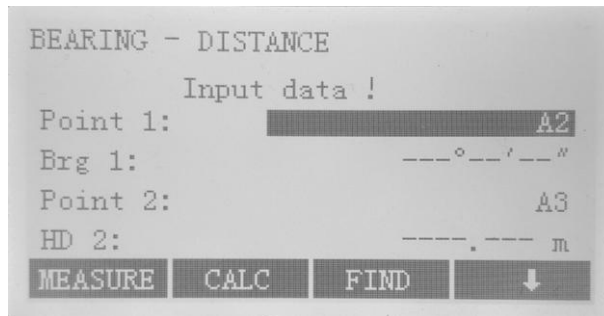
**Known**

- P1 First known point
- P2 Second known point
- $\alpha 1$  Direction from P1 to P3
- $\alpha 2$  Direction from P2 to P3

**Unknown**

- P3 COGO point

- **Bearing-Distance:** Use the bearing-distance subapplication to calculate the intersection point of a line and a circle. The line is defined by a point and a direction. The circle is defined by the center point and the radius.



**Known**

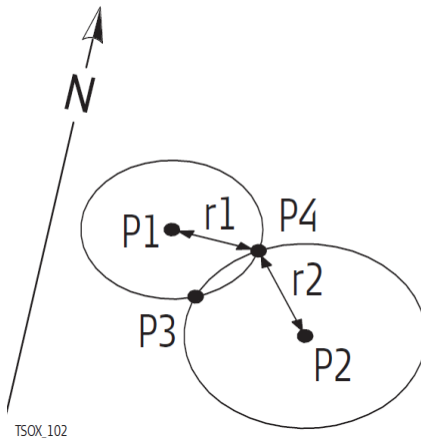
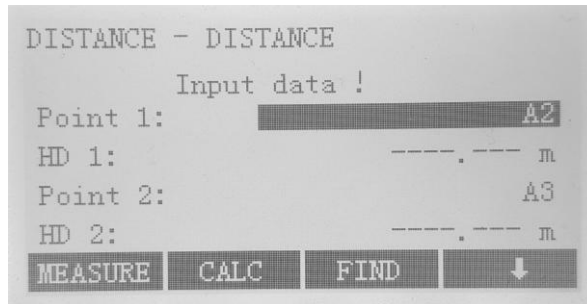
- P1 First known point
- P2 Second known point
- $\alpha$  Direction from P1 to P3 and P4
- r Radius, as the distance from P2 to P4 or P3

**Unknown**

- P3 First COGO point
- Second COGO point



- **Distance-Distance:** Use the distance-distance subapplication to calculate the intersection point of two circles. The circles are defined by the known point as the center point and the distance from the known point to the COGO point as the radius.



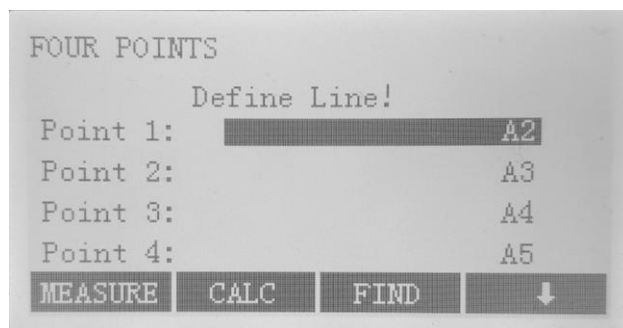
**Known**

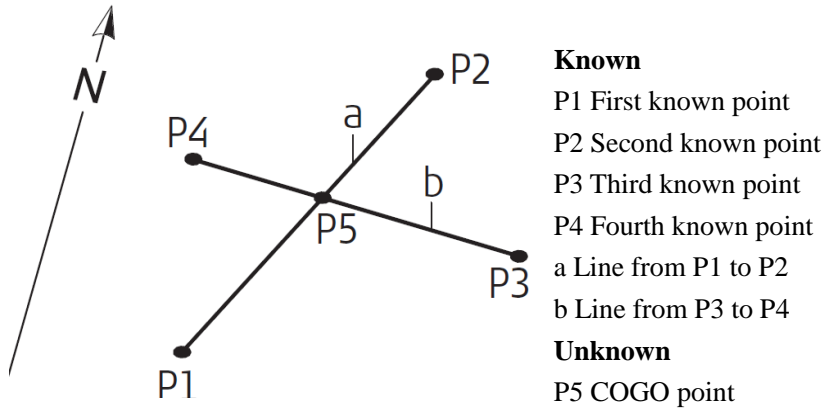
- P1 First known point
- P2 Second known point
- r1 Radius, as the distance from P1 to P3 or P4
- r2 Radius, as the distance from P2 to P3 or P4

**Unknown**

- P3 First COGO point
- P4 Second COGO point

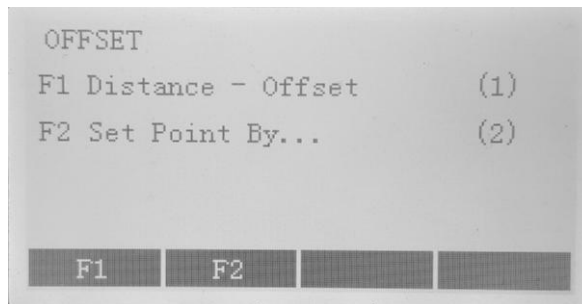
- **Four Points:** Use the line-line subapplication to calculate the intersection point of two lines. A line is defined by two points.





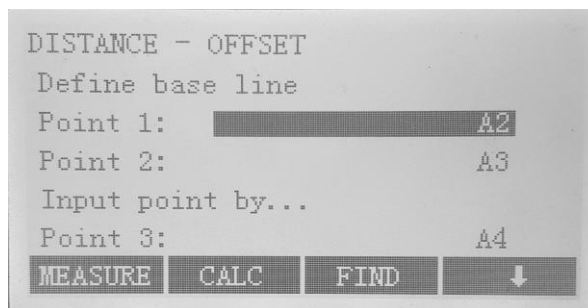
### 3. Offsets

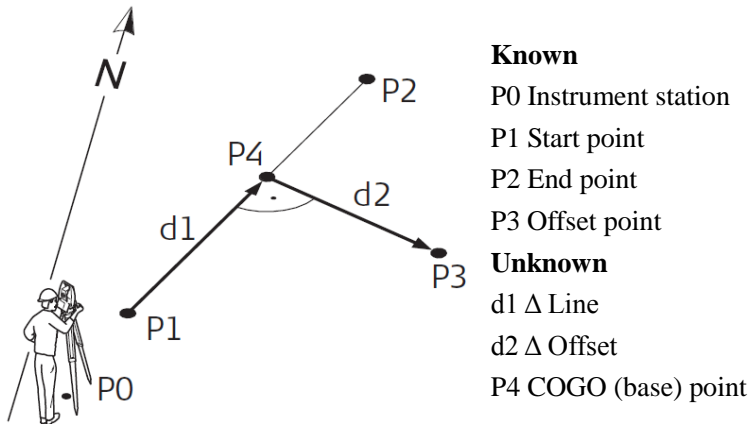
Select Offsets from the COGO MAIN MENU choose either of the three following methods to complete the application of Intersections:



#### - Distance-Offset

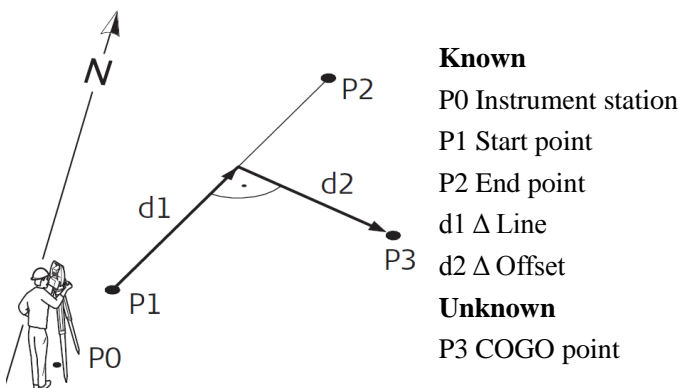
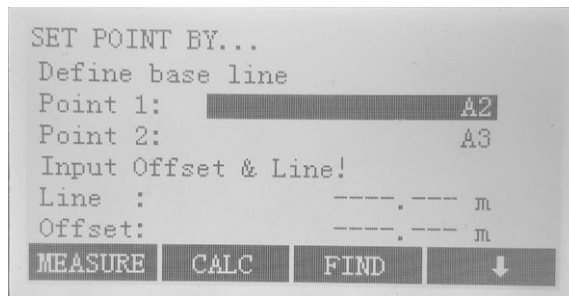
Use the distance-offset subapplication to calculate the distance and offset of a known point, with the basepoint in relation to a line.





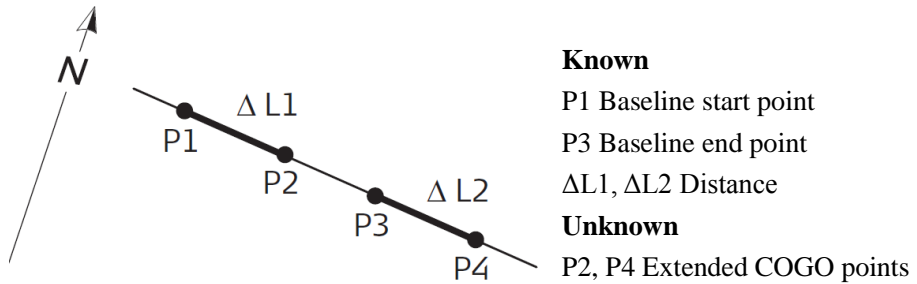
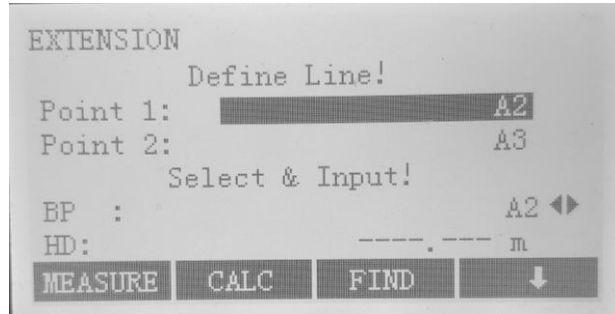
**- Set Point By...**

Use the set point subapplication to calculate the coordinates of a new point in relation to a line from known longitudinal and offset distances.



#### 4. Extension

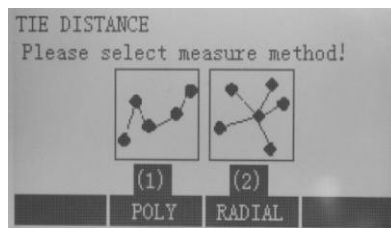
Use the Extension subapplication to calculate the extended point from a known base line.



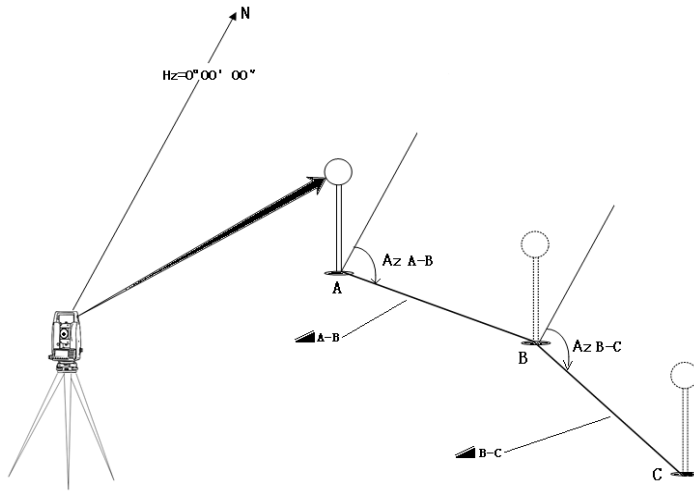
#### 4.2.2.5 Tie Distance

The application calculates slope distance, horizontal distance, height difference and azimuth of two target points measured in real time, selected from Memory or entered using the Keypad.

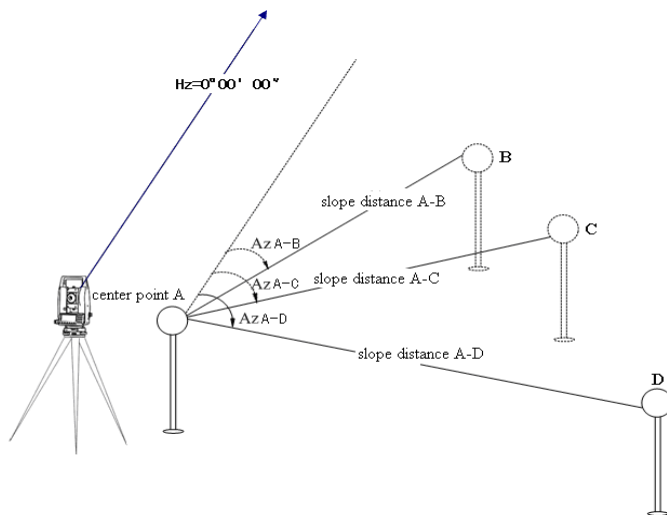
The instrument can accomplish this in two ways: Polygonal (A-B, B-C), Radial (A-B, A-C)



① Polygonal Method(A-B, B-C): Measurement is A-B, B-C, C-D, .....



② Radial (A-B, A-C): Measurement is A-B, A-C, A-D, .....



Procedure of Polygonal Method (A-B, B-C) is nearly the same as Radial (A-B, A-C) Method. Any differences will be described.

**Procedure(same):**

- a) Determine the first target point.  
[ALL] Start measuring the target point.  
[FIND] Search for certain entered point from memory.
- b) Determine the second target point.  
Proceed as with the first target point.
- c) Result is displayed.

TIE DISTANCE RESULT	1/2	TIE DISTANCE RESULT	2/2
Point 1:	A1	Point 1:	A1
Point 2:	A2	Point 2:	A2
Gradient:	100.0 %	Brg:	175°21'21"
dSD :	1.414 m		
dHD :	1.000 m		
dVD :	1.000 m		
NewTie	NEWP	RADIAL	NewTie NEWP RADIAL

HzCor: Azimuth between point1 and point2.

dSD: Slope distance between point1 and point2.

dHD: Horizontal distance between point1 and point2.

dVD: Height difference between point1 and point2.

Gradient: Grade [%] between point1 and point2.

**Soft keys(different):**

In polygonal method:

NewTie: An additional missing line will be computed. Program staNT02 again(at point 1).

NEWP: Point 2 is set as starting point of a new missing line. Program staNT02 from point 2.

RADIAL: Switch to radial method.

In radial method:

[CentPt ] Determine new center point.

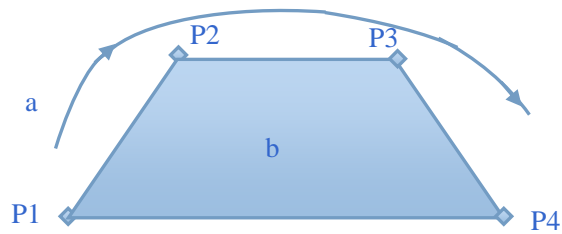
[RadPt ] Determine new radial point.

[POLY] Switch to polygonal method.

#### 4.2.2.6 Area & Volume

The application is used to calculate areas of points connected by straights in real time.

The target points can be measured in real time, selected from memory or entered via keypad.



P0: Station

P0 

P1: Start point

P2: Target point

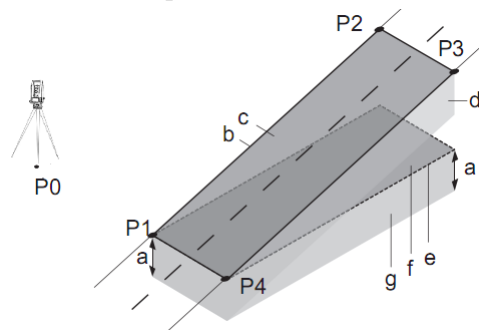
P3: Target point

P4: Target point

a: Perimeter, polygonal length from start point to the current measured point.

b: Calculated area always closed to the start point.

The calculated area is projected onto the horizontal plane (2D) or projected onto the sloped reference plane defined by 3 points (3D). Furthermore a volume with constant height can be calculated with respect to the area (2D/3D).



P0: Station

P1: Target point which defines the sloped reference plane

P2: Target point which defines the sloped reference plane

P3: Target point which defines the sloped reference plane

P4: Target point

a: constant height

b: Perimeter (3D), polygonal length from the start point to the current measured point of the area (3D)

c: Area (3D), projected onto the sloped reference plane

d: Volume (3D) =  $a \times c$

e: Perimeter (2D), polygonal length from the start point to the current measured point

of the area (2D)

f: Area (2D), projected onto the horizontal plane

g: Volume (2D) = f x a

Procedure:

① Determine area points

[ALL]: Start the measurement to the point.

[FIND]/[LIST]: Search for point from internal memory.

[ENH]: Input the coordinates manually.

[DecPt]: Undo measurement or selection of last point.

③ Results

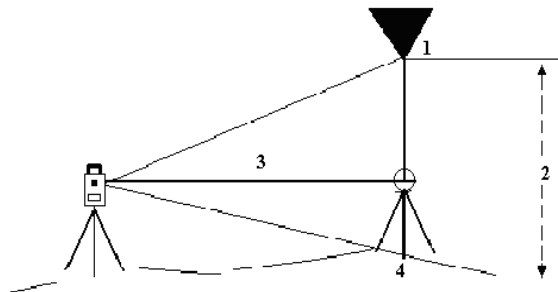
[Def. 3D]: Define the sloped reference plane by selecting or measuring three points.

[VOLUME]: Calculate a volume with constant height which has to be input or measured.

[COMPUTE]: Display and record additional results (perimeter, volume).

#### 4.2.2.7 Remote Height

The Remote Height program calculates the height difference of a remote object relative to ground. When using a prism height, the measurement will start from the prism (reference point). If no prism height is used, the measurement will start from any reference point in which the vertical angle is established. In both modes, the reference point should be perpendicular to the remote object.



1) Remote point

2) Height difference

3) Slope distance

4) Base point

Procedure:

① Input BP and prism height

[ALL]: Start measuring base point and proceed to procedure 2.

[Hr?]: Start the program that determines an unknown prism height.



1.1 [ALL]: Start measuring base point.

1.2 Aim at top of prism and confirm with [ENT].

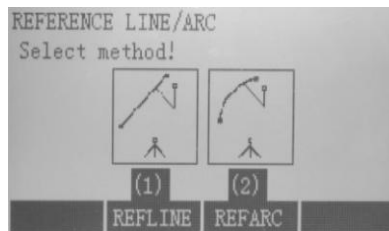
② Aim at inaccessible remote point

[SAVE]: Save the measured data.

[BasePt]: Input and start measuring a new base point.

#### 4.2.2.8 Reference Line/Arc

This program facilitates the easy stake out or checking of lines for buildings, sections of road, simple excavations, etc.

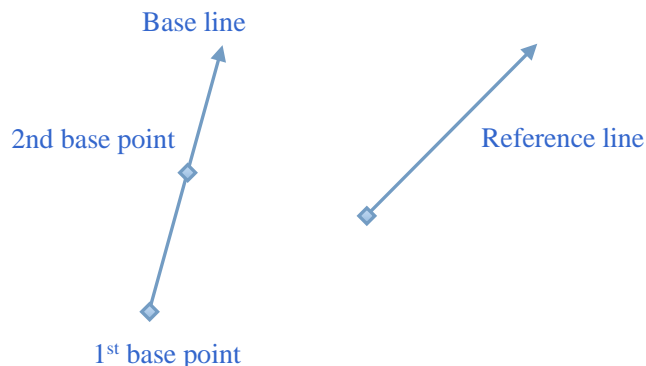


##### ① Reference Line

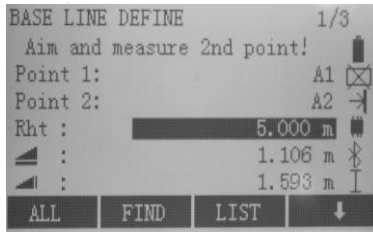
A reference line can be defined by referencing a known base line. The reference line can be offset either longitudinally, in parallel or perpendicularly to the base line, or be rotated around the first base point as desired. Besides the reference height can be selected as first point, second point or interpolated along the reference line.

Procedure:

a) Definition of the Base line

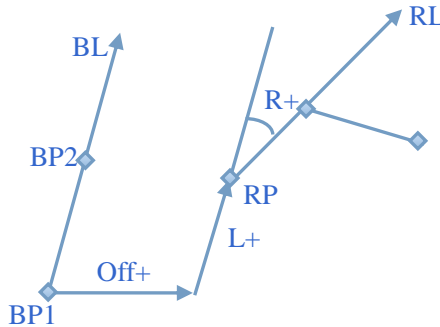


The base line is determined by two base points that can be defined in three ways: Measured points (Input PtID and measure base points with [ALL] or [DIST]/[REC]), Input coordinates manually (Press [ENH] to input), or Find points from memory (Press [FIND] to search for PtID entered or Press [LIST] to choose from a series of points).



b) Rotating the base line

After defined, the base line can be offset longitudinally, parallel and perpendicularly or rotated. This new line is called the reference line. All measured data refers to the reference line.



BP: Base point

BL: Base line

RP: Reference point

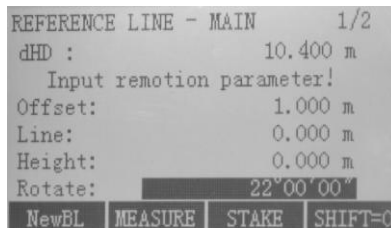
RL: Reference line

Off: Parallel offset

L: Longitudinal offset

R: Rotation parameter

**Use navigation keys to input rotation parameter**



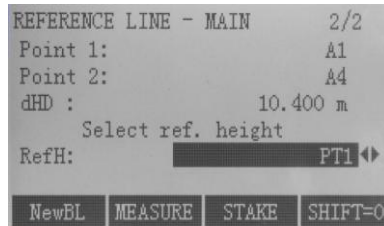
The following entries are possible:

Offset+: Parallel offset of the reference line to the right, referred to the base line (BP1-BP2).

Line+: Longitudinal offset of the reference point of the reference line in the direction of base point BP2.

Height+: Height offset. The reference line is higher than the selected reference height.

Rotate+: Rotation of the reference line clockwise around the reference point.



Ref.height:

Point 1: Height differences are computed relative to the height of the first base point.

Point 2: Height differences are computed relative to the height of the second base point.

Interpolated: Height differences are computed along the reference line.

No Height: Height differences are not computed and shown.

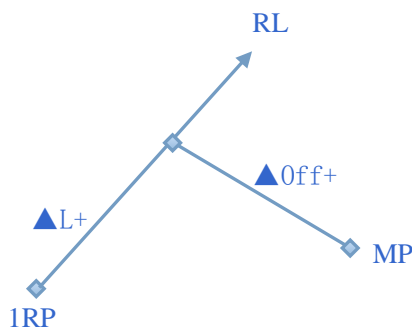
c)Decide to measure or stake out

[MEASURE] Press the key to activate Line & Offset measuring.

[STAKE] Start the application to stake out.

d)Line & Offset Measuring

The “Line & Offset” application calculates from measurements or coordinates longitudinal, parallel offsets and height differences of the target point in relation to the reference line.



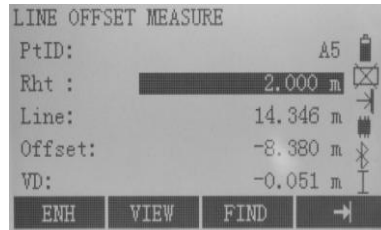
1RP: 1st reference point

MP: Measured point

RL: Reference line

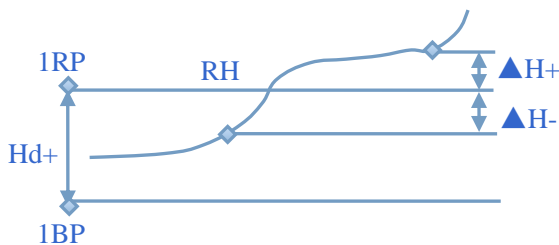
▲L: Longitudinal offset

▲Off: Parallel offset



The calculated height difference is relative to the selected reference height (VD).

### Example "relative to first reference point"



1RP: 1st reference point


1BP: 1st base point

RH: Reference height

Hd: Height difference between reference and base point

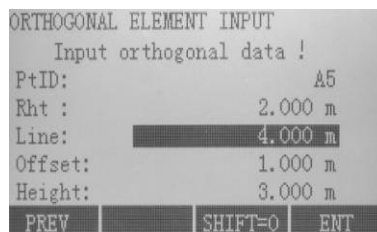
▲H: Height difference from reference height

#### e) "Stake out" application

You can enter longitudinal, transverse and height offsets for the target points to be set-out relative to the reference line. The program calculates the difference between a measured point and the calculated point. The program displays the orthogonal (Line, Offset, ) and the polar (dHz, dHD, dVD) differences.

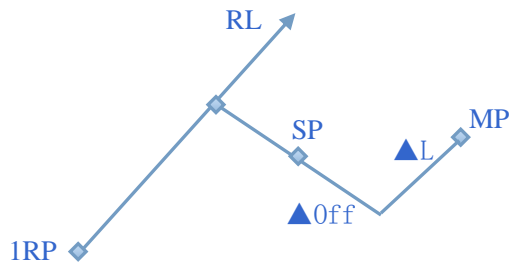
#### Procedure:

1. Input the orthogonal stake out elements.



2. Press [ENT] to confirm data entry and start calculation.

## Example "orthogonal Stake out"



1RP: 1st reference point

MP: Measured point

SP: Stake out point

RL: Reference line

▲L: Longitudinal offset

▲Off: Parallel offset

ORTHOGONAL STAKE OUT 1/2				ORTHOGONAL STAKE OUT 2/2			
PtID:		A5		PtID:		A5	
Rht :		2.000 m		Rht :		2.000 m	
dHz :	→	126°18'55"		Line:	↓	-12.233 m	
dHD :	↑	14.229 m		Offset:	→	11.687 m	
dVD :	↑	29.936 m		▲L :	↑	29.936 m	
DIST	REC	AddPt	↓	DIST	REC	AddPt	↓

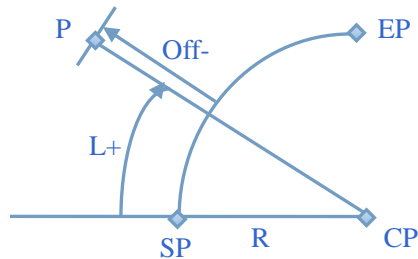
+dHz: Turn telescope clockwise to the stake out point.

+dHD: The stake out point is further away than the point measured.

+dVD: The stake out point is higher than the measured point.

## ② Reference Arc

This application permits the user to define a Reference Arc and then measure or stake out in relation to the arc.



SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

P: Point to stake

R: Radius of circle

L: Distance from start of arc along with the curve

Off: Vertical distance from arc

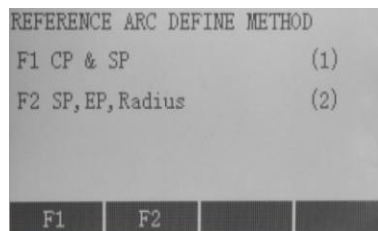
Procedure:

a) Define the arc

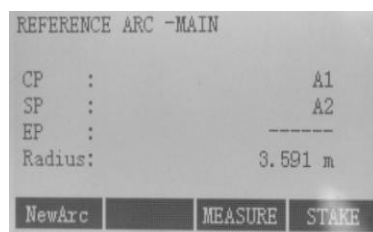
When starting the application you were offered two methods to define reference arc:

1 Center Point & Start Point

2 Start Point, End Point, Radius



Depending on the type you have chosen, you also have to define points (like Definition of the Base line) to determine the arc and proceed.



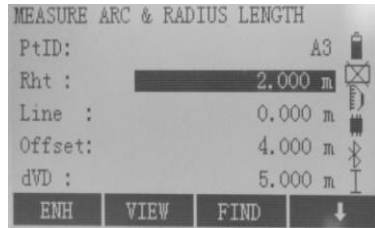
b) Decide to Measure or Stake Out

[MEASURE] Press the key to activate Line & Offset measuring.

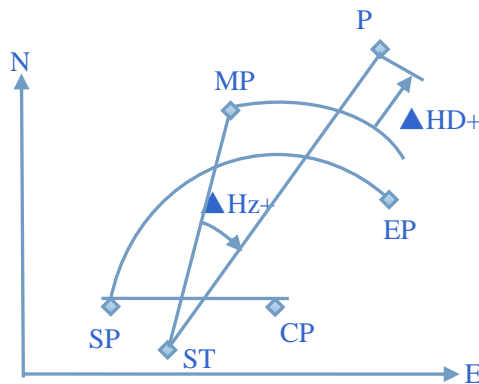
[STAKE] Start the program to stake out.

c)"Line & Offset" Measuring

Here you can measure, select points from memory or input coordinates manually and then Line and Offset values referring to the arc will display.



d)"Stake Out" application



ST: Station

SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

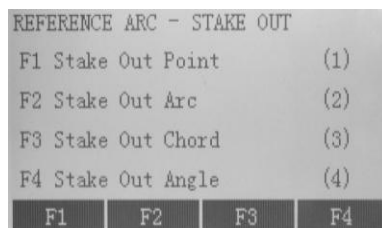
P: Point to stake out

MP: Measured point

▲Hz: Difference in horizontal angle

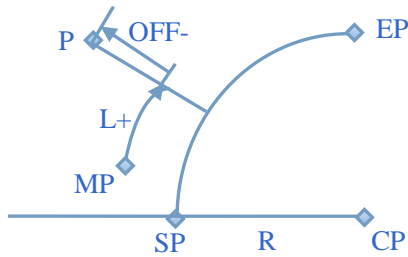
▲HD: Difference in distance measurement

Notably there are four ways available for this application: **Stake Out Point, Stake Out Arc, Stake Out Chord, Stake Out Angle.**



## 1 Stake Out Point

This allows to stake out a point by entering a line and an offset value.



SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

P: Point to stake out

MP: Measured point

R: Radius of circle

L: Line

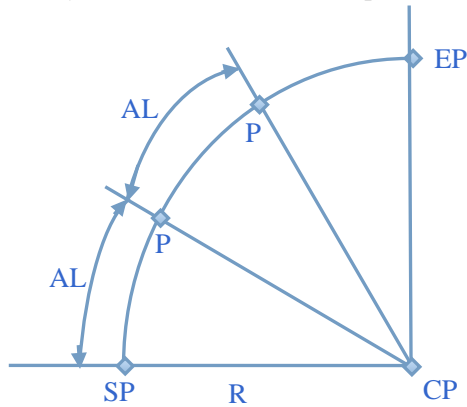
Off: Vertical distance from arc

STAKE OUT - POINT		REFERENCE ARC STAKE OUT	
PtID:	A3	PtID:	A3
Line :	3.000 m	Rht :	2.000 m
Offset:	2.000 m	dHz :	← -27°10'39"
		dHD :	↑ 14.576 m
		dVD :	↑ 32.745 m
RESET		ENT	
		DIST	
		REC	
		AddPt	



## 2 Stake Out Arc

This gives possibility to stake out a series of equidistant points along with the arc.



SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

P: Point(s) to stake out

AL: Arc length

STAKE OUT - ARC		REFERENCE ARC STAKE OUT	
PtID:	A3	PtID:	A3
Misclosure:	Start Point	Rht :	2.000 m
Arc Length:	8.000 m	dHz :	108°22'59"
Line :	14.561 m	dHD :	14.576 m
Offset:	0.000 m	dVD :	32.745 m
RESET	PT-	PT+	ENT
		DIST	REC
		AddPt	↓

If the input arc length is not an integer of the whole arc, there will be a closure. And three distribution ways are provided: Start Point, End Point and Average.

[1] Start Point: All of the closure will be added to the first segment of arc.

[2] End Point: All of the closure will be added to the last segment of arc.

[3] Average: The closure will be equally distributed among all segments.

[4] Arc Length: Input the length of the arc-segment which you want to stake out.

[5] Line: Display the line-value of the stake out point. This is calculated by the arc length and the selected closure distribution.

[6] Offset: Input the offset value here.

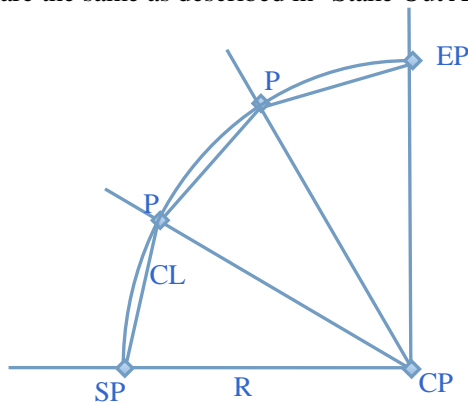
[7] [RESET]: Set all values to 0.

[8] [PT +] [PT -]: Toggle through the calculated stake out points.

[9] [ENT]: Proceed to Stake Out display.

### 3 Stake Out Chord

This allows to stake out series of equidistant chords along with the arc. The contents and the soft key functions are the same as described in "Stake Out Arc" section.

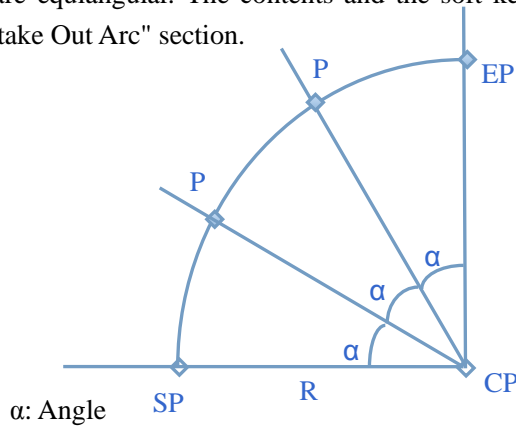


CL: Chord length

STAKE OUT - CHORD		REFERENCE ARC STAKE OUT	
PtID:	A3	PtID:	A3
Misclosure:	Start Point	Rht :	2.000 m
Chord Length:	4.000 m	dHz :	→ 30°51'35"
Line :	5.591 m	dHD :	↑ 14.576 m
Offset:	0.000 m	dVD :	↑ 32.745 m
RESET	PT-	PT+	ENT
		DIST	REC
		AddPt	↓

### 4 Stake Out Angle

This allows to stake out series of angles which are determined by the points of arc and whose values are equiangular. The contents and the soft key functions are the same as described in "Stake Out Arc" section.



$\alpha$ : Angle

STAKE OUT - ANGLE		REFERENCE ARC STAKE OUT	
PtID:	A3	PtID:	A3
Misclosure:	Start Point	Rht :	2.000 m
Angle:	20°00'00"	dHz :	← -48°00'37"
Line :	1.253 m	dHD :	↑ 14.576 m
Offset:	0.000 m	dVD :	↑ 32.745 m
RESET	PT-	PT+	ENT
		DIST	REC
		AddPt	↓

#### 4.2.2.9 Construction

This application allows defining a construction site by combining set-up of the instrument along with a construction line, measuring and stake out points relative to the line. After starting this program, there will be four options provided: Set Job, Set EDM, New construction site, Continue previous site.

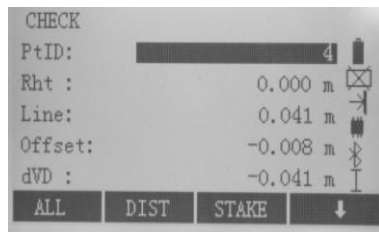
Procedure:

New construction site:

- ① Measure start point of this construction line.
- ② Measure second end point of this construction line.

#### Check display:

This dialog shows you the Line, Offset and dVD (Height of a measured point in relation to the line).



[MAxis]: Allow you to input values for shifting the line.

[STAKE]: Switch to stake out mode.

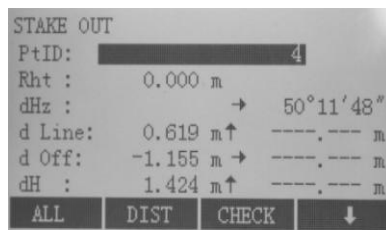
**Note:** “Line” is positive: Measured point is in the direction from line start point to line end point.

“Offset” is positive: Measured point is on the right of this line.

“dVD” is positive: Measured point is above line start point.

#### Stake out display:

Here you can search or enter points for setting out related to the measured line.



[MAxis]: Allow you to input values for shifting the line.

[Check ]: Switch to check mode.

The figure shows you the position of the prism in relation to the stake out point. Furthermore, the accurate values are displayed, combined with the arrows indicating the direction.

“d Line” is positive (arrow up): Target point is further away than the measured point.  
 “d Off” is positive (arrow right): Target point is on the right of the measured point.  
 “dH” is positive (arrow up): Target point is higher than the measured point.

#### 4.2.2.10 Lead Measure

This application is used for survey of hierarchical control traversing and mapping traversing etc. and adjustment and computation of closure.

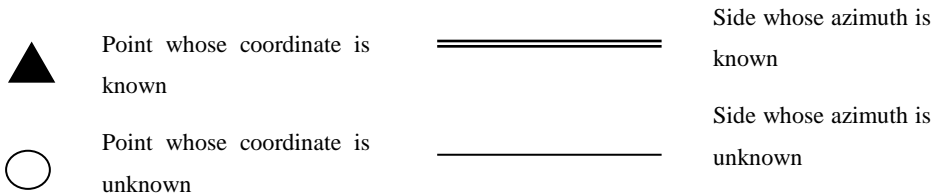
##### ① Introduction

- a) fundamental
  - Station distribution method(closure adjustment method of azimuth )
  - Distance distribution method(closure adjustment method of coordinate)
- b) Applied Characteristics

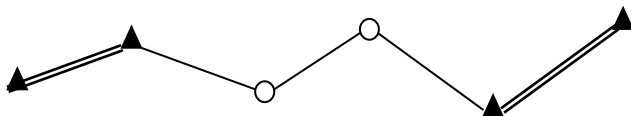
##### [1] Program Capacity

- Six sets of observation is upper limit to every survey station.
- The maximum number of observing directions is 2 as for survey station(i.e. only traverse point measuring supported except for branch point measuring).
- The maximum number of survey stations is 30 as for single lead.

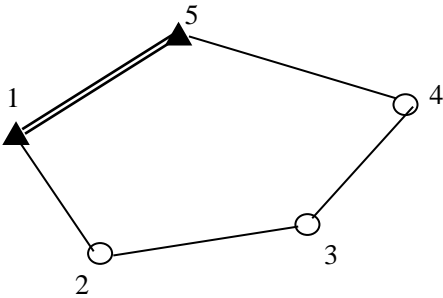
##### [2] Available lead type



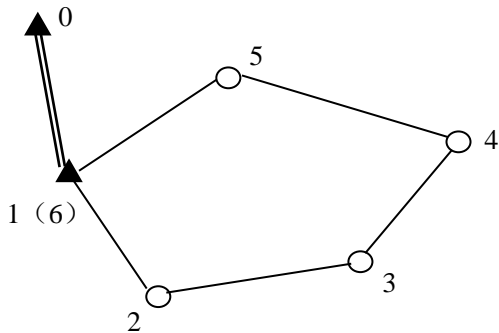
I .Coordinates of occupied point and backsight point of the first survey station are known, so are coordinates of occupied point and foresight point of the last survey station.



II. Coordinates of the first traverse point(point 1) and the last one(point 5) on the lead are known.

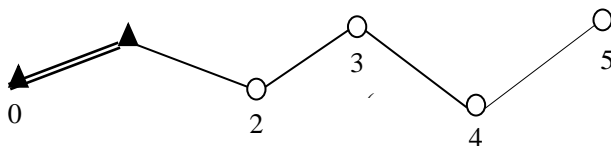


III. Coordinates of the first traverse point(point 1) on the lead and another point(point 0) off the lead are known.



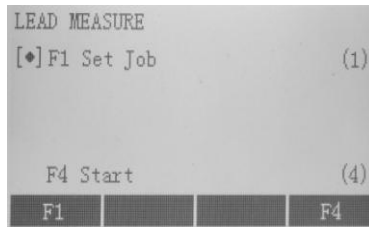
**Note:** As to this type of traverse measuring, the last survey station must be measured again on where point 1 is, but occupied point can't be set to point 1, otherwise this operation will make measurements of the first survey station covered. For example, occupied point of the last survey station can be set to point 6 whose coordinate inputting is the same as point 1's.

IV. Coordinates of occupied point and backsight point of the first survey station are known, namely, it's open(branch) traverse as shown in below figure.

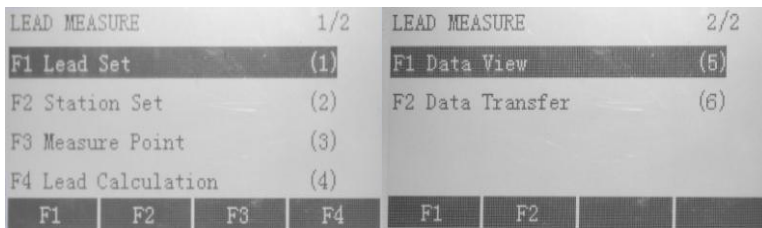


② Procedure

a)As shown, press F1 to set job. After job prepared, back to start-up display.



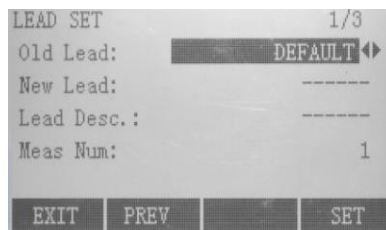
b)Press F4 to start operation of lead measure. It contains two pages, as shown, through which you can toggle by “PAGE” key.



[1] Lead Set

On the first page of “Lead Measure” press F1 to activate lead setting which consists of three pages.

At first input “Lead Name”, “Lead Desc” and “Meas Num”.



**Display Content:**

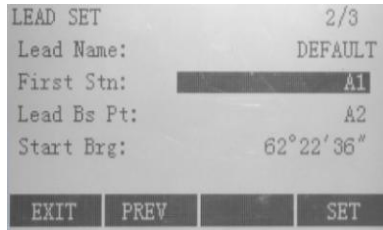
**Old Lead:** Existed old lead name.

**New Lead:** New lead name.

**Lead Desc:** Lead Description.

**Meas Num:** The number of observation sets.

Next, press “PAGE” key or “SET” key to proceed. On the second page, you can input “First Stn”, “Lead Bs Pt” and “Start Brg”.After inputting press “SET” key to quit “Lead Set” dialog and return “Lead Measure” dialog.



**Display Content:**

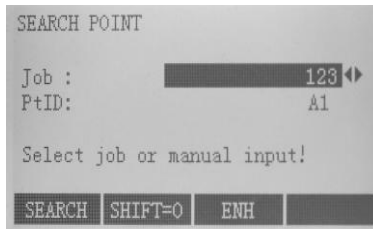
**Lead Name:** Determined lead name.

**First Stn:** The first survey station.

**Lead Bs Pt:** Lead backsight point.

**Start Brg:** Initial azimuth.

**Note:** 1. When moving screen cursor to “First Stn” and “Lead Bs Pt” in order to import point name, you can press “ENT” key to search and determine the point you need, as shown.

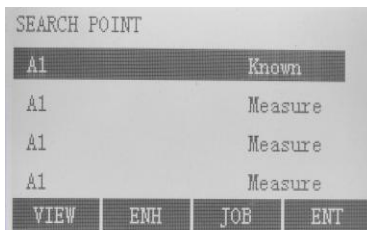


[SEARCH]: To search existed known point.

[SHIFT=0]: To set all coordinates to 0.

[ENH]: To input coordinates, as below figure shows.

If the point is known point, it will display like this:

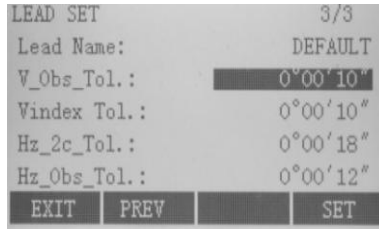


2. It is allowable to delay inputting coordinates of the first station and lead backsight point for the moment. And you can proceed with “Station Set” and “Measure Point” followed by “Lead Calculation” before which continue entering coordinates of the first station and lead backsight point on “Lead Set” dialog. This function is convenient for field survey where lead measure can go on in certain case that coordinates of known point can’t be attained temporarily.

3. In addition, if continuing unfinished lead, you can select the lead which needs proceeding on the first page of “Lead Set” dialog, then end lead setting by pressing “SET”

key.

Step three, press “PAGE” key to set tolerance on the third page, as shown.



**Display Content:**

**Lead Name:** Determined lead name.

**V\_Obs\_Tol:** Discrepancy tolerance of vertical angles among observation sets.

**Vindex Tol:** Discrepancy tolerance of vertical index error.

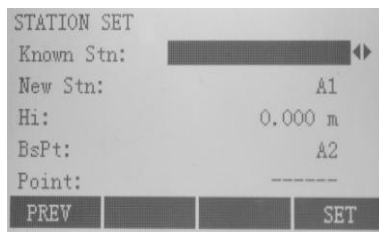
**Hz\_2c\_Tol:** Discrepancy tolerance of horizontal collimation error C.

**Hz\_Obs\_Tol:** Discrepancy tolerance of horizontal angles among observation sets.

**Note:** Horizontal angle defaults to tolerance of engineering first-order traverse, and vertical angle defaults to tolerance of the fifth class triangular elevation.

[2] Station Set

On the first page of “Lead Measure” dialog press F2 to activate station setting, as shown.



**Display Content:**

**Known Stn:** Known survey station.

**New Stn:** New survey station.

**Hi:** Height of instrument.

**BsPt:** Backsight point.

**Point:** Foresight point.

**Note:**1. Here foresight point must be input. Then press “SET” key to finish station setting and return “Lead Measure” dialog. It's worth noting that instrument height is defaulted to 0. And you must input accurate “Hi” before pressing “SET”, otherwise the buzzer sounds and proceeding operation is impossible.

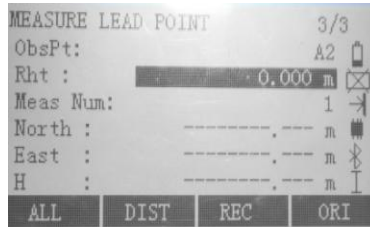
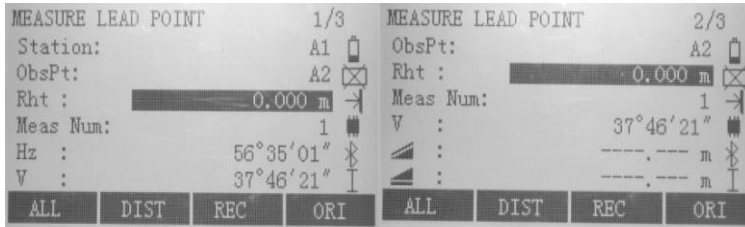
2.If mistake is found after station setting succeeds, you need to press “ESC” key to quit the entire program and reenter.

[3] Measure Point

On the first page of “Lead Measure” press F3 to access “Measure Lead Point” dialog



which consists of three pages, as shown.



**Display Content:**

**Station:** Current survey station.

**ObsPt:** Observed point.

**Rht:** Prism height.

**Meas Num:** The number of observation sets.

**Hz:** Horizontal angle.

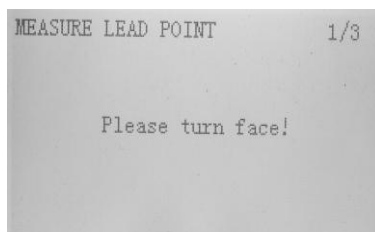
**V:** Vertical angle.

**North:** Ordinate of measured lead point.

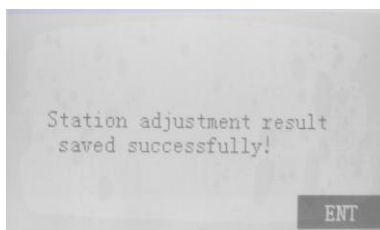
**East:** Abscissa of measured lead point.

**H:** Elevation of measured lead point.

A popup dialog displays after semiobservation:



A popup dialog displays after one observation set:



**Note:**1. Prism heights of foresight and backsight must be input during the first semiobservation of the first observation set. It's worth noting that these prism heights are defaulted to 0. And you must input accurate “Rht” before pressing “DIST” or “ALL”, otherwise the buzzer sounds and proceeding operation is impossible.

2.All foresight observed points need distance measuring unless foresight points are known. Distance measuring of backsight points can be ignored, but it is proposed.

#### [4] Lead Calculation

Repeat “Station Set” and “Measure Point” until all station surveys are complete. Thus lead calculation can be carried on.

```

LEAD CALCULATION
Lead Name:                2
Lead Desc.:              -----
Press ENT select station!
Last Stn :                [REDACTED]
Last FsPt:               -----
End Azimuth:             ___°'"/
PREV          CALC
  
```

Similar with “Lead Set”, when moving screen cursor to “Last Stn” and “Last FsPt”, you can press “ENT” key to search the point you need or input coordinates.

**Note:**1.If the lead belongs to branch traverse, directly press “CALC” key to compute coordinates of each lead point of branch traverse.

```

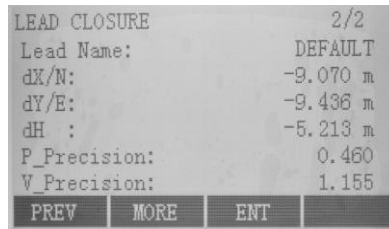
LEAD CALCULATION
Lead Name:                DEFAULT
Lead Desc.:              -----
Press ENT select station!
Last Stn :                A3
Last FsPt:               A4
End Azimuth:             [REDACTED] 25°00'00"
PREV          CALC
  
```

After pressing “CALC”, a dialog about lead closure will eject.

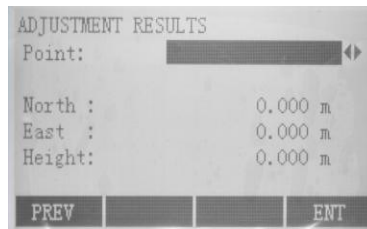
```

LEAD CLOSURE              1/2
Lead Name:                DEFAULT
LeadPt Num:              2
Lead Length:             6.020 m
Pla.Closure:             13.088 m
Ver.Closure:             -5.213 m
Ang.Closure:             355°21'37"
PREV  MORE  ENT
  
```

Press "PAGE" to switch to page 2, as shown.



Press "more" to check "calculation results", especially coordinates of each lead point after computing.

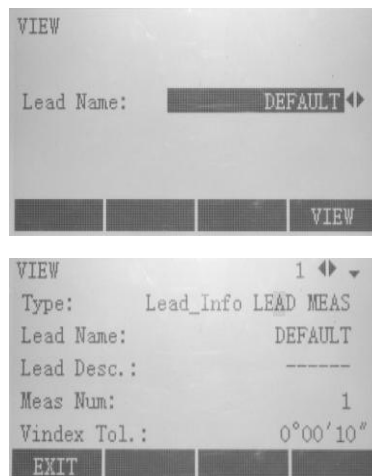


**Note:**

◀▶: With the function key, scroll between observed points.

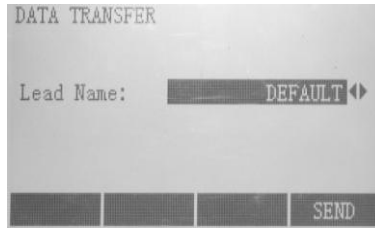
#### [5] Data View

Press "PAGE" button to switch to page 2 of "Lead Measure", and then select "F1" or "5" to enter into "Data View" where you can know about information according to the lead you choose.



#### [6] Data Transfer

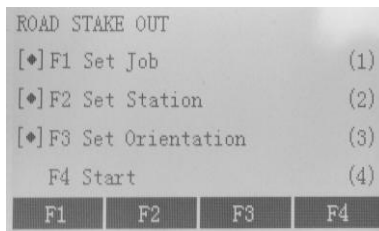
Press “PAGE” button to switch to page 2 of “Lead Measure”, and then select “F2” or “6” to enter into “Data Transfer” where you can send data to PC.



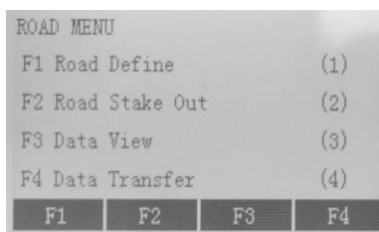
#### 4.2.2.11 2D-Road

Procedure:

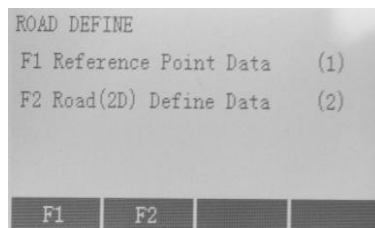
- ① Start the program “2D-Road” and access the below display. Then finish job, station and orientation settings continuously.



- ② Press F4 to enter into Road Menu which includes Road Define, Road Stake Out, Data View and Data Transfer.

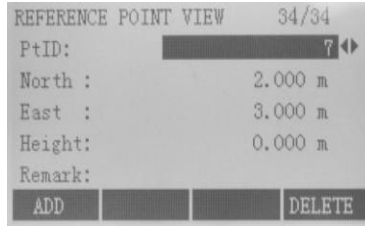


- ③ Choose soft key F1 or number key 1, and then display Road Define dialog.



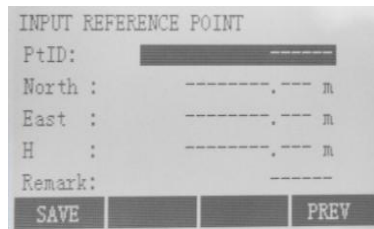
a)Reference Point Data

Point here means reference point (control point) including each grade of known plane point and known elevation point that can be used for setting station and orientation. In the dialog of Reference Point View, existed control points only can be available for scan and deletion but not edit.



[ADD]: Input of new reference point, as shown in the below figure.

[DELETE]: Delete current displayed reference point and the erased data can't resume.



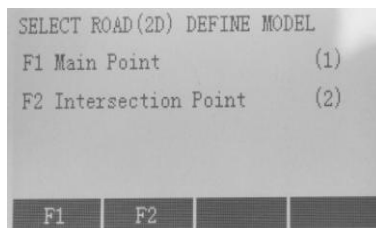
[SAVE]: Save the new input of reference point.

[PREV]: Return Road Define dialog.

**Note:** Under inputting reference point mode, press the fixed key [ESC] to withdraw and return Reference Point View dialog.

#### b) Road(2D) Define Data

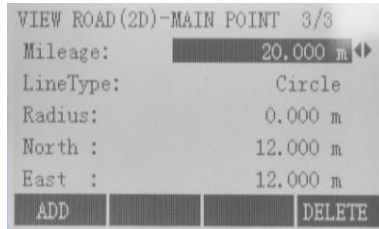
This application is used to describe and determine road centerlines. As shown, there are two models available for definition of road(2D): Main Point, Intersection Point.



#### [1] Main Point

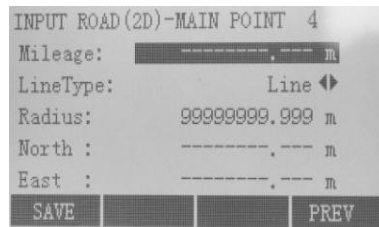
This application utilizes main point information relative to the line to describe the entire road. Main point is the key point where the linetype changes along with the line. It includes start point, end point and so on. This method can solve any complicated linetype including ramp. In the dialog of View Road(2D)-Main Point, existed main points only can

be available for scan and deletion but not edit.



[ADD]: Input of new main point, as shown in the below figure.

[DELETE]: Delete current displayed main point and the erased data can't resume.



[SAVE]: Save the new input of main point.

[PREV]: Return Road Define dialog.

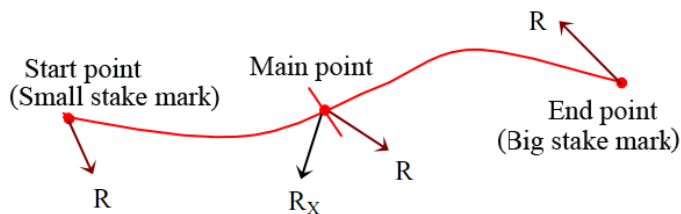
**Note:** Under main point inputting mode, press the fixed key [ESC] to withdraw and return View Road(2D)-Main Point.

**Display Content:**

**Mileage:** The stake mark of mainpoint on the road centreline. Within the input format can not be included certain characters “K”, “k” and “+” etc. For example,2224.224 can be input instead of K2+224.224.

**LineType :** The litype of route preceding main point(Big stake mark direction) can be selected from four options: Line, Circle(Round Curve),Spiral(Easement Curve) and End Point.

**Radius:** Except the end point of route, the “Radius” of any point represents the radius of curvature (“R” in the below figure) of one side preceding main point (Big stake mark direction). When route turns left, the radius will be negative; Conversely, the radius will be positive. When radius of curvature is infinite, the radius value should be set to:99999999.999 or -99999999.999.



**North:** Ordinate of main point

**East:** Abscissa of main point

## [2] Intersection Point

This application is to describe the entire road with information of intersection point of the route. This method is appropriate for the linetype whose intersection points are symmetrical, and start point and end point of the route must be on the straight line segment or its vertex points. That intersection points are symmetrical means their corresponding tangent lines are equi-long. In the dialog of View Road(2D)-Intersection, existed main points only can be available for scan and deletion but not edit.

VIEW ROAD (2D)-INTERSECTION 2/2	
Mileage:	220.000
North :	2.000 m
East :	4.000 m
Turn:	0°00'00"
Radius:	9.000 m
Spiral Len:	6.000 m
ADD	DELETE

[ADD]: Input of new intersection point, as shown in the below figure.

[DELETE]: Delete current displayed intersection point and other intersection points whose mileage is larger than the current one, the erased data can't resume. It's worth noting that, different from main point method, pressing [DELETE] key may lead to erasing of several intersection points.

INPUT ROAD (2D)-INTERSECTION 3	
Mileage:	----- m
North :	----- m
East :	----- m
Turn:	---°--'--"
Radius:	----- m
Spiral Len:	----- m
SAVE	PREV

[SAVE]: Save the new input of intersection point.

[PREV]: Return Road Define dialog.

**Note:** Under intersection point inputting mode, press the fixed key [ESC] to withdraw and return View Road(2D)-Intersection.

### Display Content:

**Mileage:** The stake mark of intersection point. Within the input format can not be included certain characters “K”, “k” and “+” etc. For example, 2224.224 can be input instead of K2+224.224.

**North:** Ordinate of intersection point

**East:** Abscissa of intersection point

**Turn:** Turn angle of one intersection point relative to the route (Turn angles of start point and end point should be set to 0).

**Radius:** The radius of curvature of circular curve corresponding to intersection point.

When route turns left, the radius will be negative; Conversely, the radius will be positive. At the place of start point and end point of route, the curvature radius value must be set to:99999999.999 or -99999999.999.

**Spiral len:** Easement curve length relevant to intersection point. Set to 0 in the situation where there's no easement curve.

**Note:** 1. When using intersection point method, input data successively in accordance with mileage(small to large) of intersection point. And the first and the last intersection point must be on the straight line segment of the road centreline.

2.When using main point method, you can input data out of accordance with mileage of main point, but don't miss out any main point finally. It's recommended to input data successively according to mileage magnitude in support of check and verification.

3.The datum input with main point method can't be viewed and edited in the form of intersection point method, i.e., intersection point method will be disabled if import in the form of main point; But differently the datum entered in the form of intersection point can be viewed and added in the form of main point, except for deletion.

4.Affected by precision of turn angle, there may exists deviation in main point datum converted by intersection point datum.

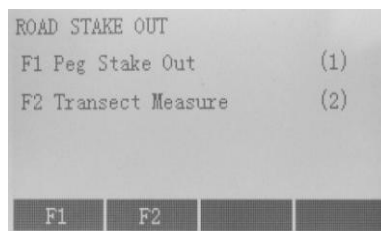
5.No matter what kind of method (main point or intersection point) you choose, normal stake out and measuring can be executed based on the requirement of input of at least two valid records (two valid main points or intersection points).

6.It is advisable to input data with main point method and directly upload plane alignment data to instrument with desktop tool. The plane alignment data uploaded directly can't be viewed and edited in the form of intersection point.

7.No matter what kind of method (main point or intersection point), its maximum mileage mustn't be greater than 4294000.000m, i.e., the route's maximum mileage mustn't be more than K4294+000.000m.

#### ④ Road Stake Out

Choose soft key F2 or number key 2, and then display Road Stake Out dialog. As shown, this function is mainly used to realize Peg Stake Out and Transect Measure.

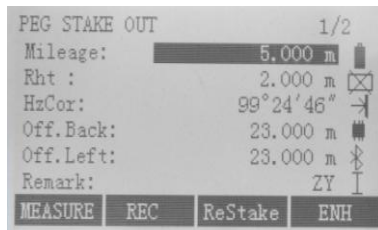


#### a)Peg Stake Out

On "Road Stake Out" display, press soft key F1 or number key 1 to access "Peg



Stake Out” dialog. Before stake out, as required press “PAGE” key and switch to the second page in order to set “Stake Distance”, “Offset” and “Deviation Angle”.



[MEASURE]: Measuring distance and angle.

[REC]: Save stake out result, and make stake mark increase by stake distance.

[ReStake]: Make stake mark decrease by stake distance.

[ENH]: Access “Stake Out Point Coordinates” dialog, and view design coordinates of point to be stake out.

**Display Content:**

**Mileage:** The stake mark of point to be stake out. Within the input format can not be included certain characters “K”. “k” and “+” etc. For example,2224.224 can be input instead of K2+224.224.

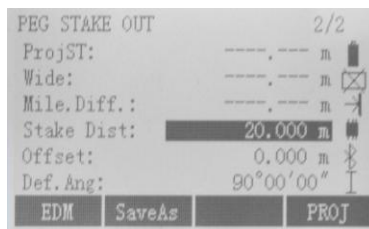
**Rht:** Input the accurate prism height before measuring.

**Hzcor:** Included angle between current collimation axis direction and theoretical direction (point to the point to be stake out). That this value becomes 0 means the instrument points to the point to be stake out.

**Off.Back:** Take the direction where prism worker faces the instrument as reference direction. And if the value is positive, prism worker should be aloof from the instrument. Conversely, prism worker should be close to the instrument.

**Off.Left:** Take the direction where prism worker faces the instrument as reference direction. And if the value is positive, prism worker should move left. Conversely, prism worker should move right.

**Remark:** Simple description of the current point.



[EDM]: Switch to “EDM Settings” dialog.

[SaveAs]: Store current measured point as reference point (control point) whose name is current mileage.

[PROJ]: Set mileage as current **ProjST** (projection stake). This function is useful when add stakes on terrain or surface features to set out.

**Display Content:**

**ProjST:** Stake mark corresponding to current measured point projected onto route centreline.

**Wide:** Distance of offset that current measured point deviates from centreline.

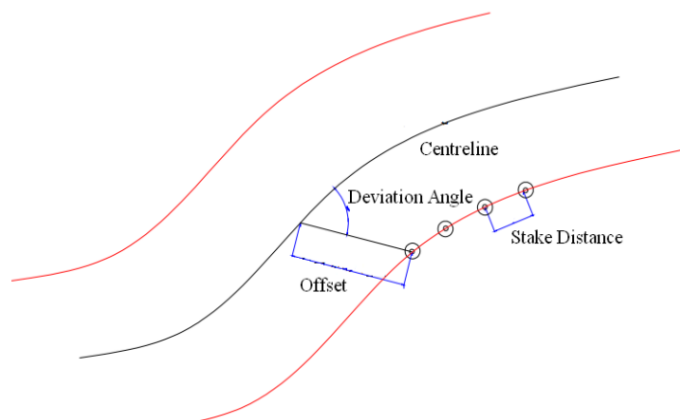
**Mile.Diff:** Difference between ProjSt and Mileage.

**Stake Distance:** Mileage increment when stake out. And this value will be negative when stake out from big stake mark to small stake mark.

**Offset:** Distance between the point to be stake out and its corresponding mileage of centerline (Not always the perpendicular distance from stake out point to centreline). That this value is 0 indicates middle-stake. But if this value is negative, it means left side-stake; Otherwise, it means right side-stake.

**Def.Ang (Deviation Angle):** Included angle generated from centreline and connecting line between the point to be stake out and its corresponding mileage of centreline. And its range is  $(0, \pi)$ . It's necessary to refer to deviation angle when set out particular point (such as bridge pier) and side-stake whose connecting line is not orthogonal but intersected with the route.

Specific meaning with respect to **Stake Distance**, **Offset** and **Deviation Angle** is shown in the below figure:



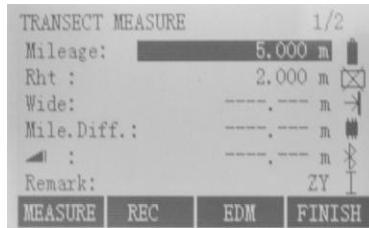
**Note:**1. Make sure **Offset**, **Deviation Angle** and **Stake Distance** are set correctly when peg stake out.

2. With the increment of main point datum of plane alignment, running speed of certain links during peg stake out can be slowed down.

3. Peg stake out result can be used as transect measure result.

b) Transect Measure

On “Road Stake Out” display, press soft key F2 or numberkey 2 to access “Transect Measure” dialog.



[MEASURE]: Measuring distance and angle.

[REC]: Save current measurement result.

[EDM]: Switch to “EDM Settings” dialog.

[FINISH]: Complete current transect measuring, and make mileage successively increase to next transect by stake distance.

**Display Content:**

**Mileage:** Stake mark corresponding to transect to be measured.

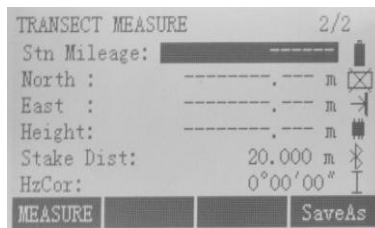
**Rht:** Input the accurate prism height before measuring.

**Wide:** Distance of offset that current measured point deviates from centreline.

**Mile.Diff:** It means the one that is the projection onto current sideline of difference between mileage corresponding to current measured point and specified mileage. The value will be positive if mileage corresponding to current measured point is greater than specified mileage; Conversely, It is negative. Prism worker can move the prism to specified transect according to this field value.

▲: The height difference between current measured point and the last one.

**Remark:** It can be used when saved as reference point, and it’s simple description of the reference point to be stored.



[SaveAs]: Store current measured point as reference point (control point) whose name is Stn Mileage.

**Display Content:**

**Stn Mileage:** Stake mark of current occupied point(station);(When save as, this field will made as point number).

**North:** Ordinate of current measured point.

**East:** Abscissa of current measured point.

**Height:** Elevation of current measured point.

**Stake Distance:** Mileage increment when transect measuring. And this value will be negative when measuring from big stake mark to small stake mark.

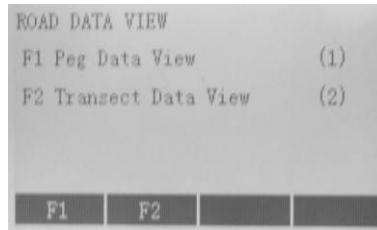
**HxCor:** Included angle between current collimation axis direction and “normal” direction of mileage of occupied point which is perpendicular to the transect route. If measuring the transect where occupied point lies, adjust this angle to 0 degree or 180 degrees.

**Note:**1. During stake out and measuring, if the elevation of occupied point is unknown, this value will be defaulted to “-9999.000” meters.

2. During transect measuring, if current measured point is not within the control of plane alignment, valid width and mileage difference can't be calculated, thus this measured point will not be saved.

**⑥Data View**

Under Road Menu, choose soft key F3 or numberkey 3, and then display “Road Data View” dialog. As shown, this function is to realize data view of peg stake out and transect measure. All the results can be available for scan and deletion but not edit and modification.



a) On “Road Data View” display, press soft key F1 or numberkey 1 to access “Peg Data View” dialog.

[PREV]: Return “Road Data View” dialog.

[CLEAR]: Delete all results of peg stake out in current job. Deleted data can’t resume.

[DELETE]: Delete current displayed records. Deleted data can’t resume.

**Display Content:**

**Mileage:** Mileage of specified stake out point.

**Offset:** Distance of offset that specified stake out point deviates from centreline, namely, “Offset” on “Peg Stake Out” display.

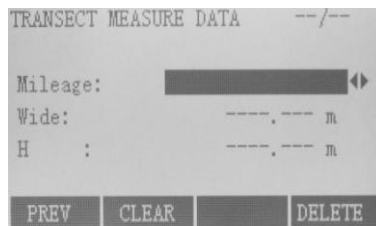
**North:** Ordinate of actual measured point.

**East:** Abscissa of actual measured point.

**Height:** Elevation of actual measured point.

**Remark:** Simple description of actual measured point.

b) On “Road Data View” display, press soft key F2 or numberkey 2 to access “Transect Data View” dialog.



[PREV]: Return “Road Data View” dialog.

[CLEAR]: Delete all results of transect measure in current job. Deleted data can’t resume.

[DELETE]: Delete current displayed records. Deleted data can’t resume.

**Display Content:**

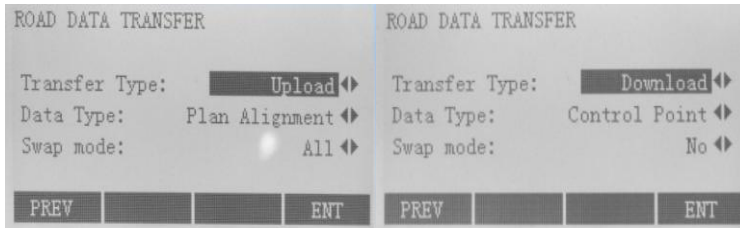
**Mileage:** Mileage corresponding to the transect.

**Wide:** Distance of offset that cross-sectional point deviates from centreline.

**H:** Actual elevation of this measured point.

## ⑦ Data Transfer

Under Road Menu, choose soft key F4 or numberkey 4, and then display “Data Transfer” dialog. This function is to realize known data uploading (Control point and Plane alignment) and results downloading of stake out and measuring.



As shown, transfer type contains two options: Upload, Download. Upload: It helps to upload data to total station via PC. And this operation is only appropriate for known data (Control point and Plane alignment); Download: It helps to send data to PC via total station, and this operation is appropriate for all types of data.

Data type contains four options: Control point, Plane alignment, Cross-sectional and Stakeout Results.

Swap mode only includes two choice: All, No. All: It'll delete the same types of all existed data in current job. No: It won't delete the same types of existed data.

**Note:** When selecting upload, swap mode will be limited to All. It's recommended that better download original data and backup them before uploading. When selecting download, swap mode will be limited to No.

## 5 Settings

### 5.1 Contrast

It's possible to set the same contrast as in the above star settings.

### 5.2 Trigger key

Press left or right direction keys to adjust it. Define the side red button as a fixed function which can be chosen among three options (ALL, DIST and off).

### 5.3 USER Key

Press left or right direction keys to adjust it. Each function from the [FUNC] menu can be set as the [USER] key, which makes [USER] key on keypad act as a shortcut key.

### 5.4 V-setting

The "0"- orientation of the vertical circle can be either selected for the zenith, the horizontal plane or in %.

Zenith: Zenith=0°, Horizontal=90°

Horizon: Zenith=90°, Horizontal=0°

V-(%): 45°=100%, Horizontal=0°

### 5.5 Tilt Correction

It's possible to set the same tilt correction as in the above star settings.

### 5.6 Horizontal Collimation

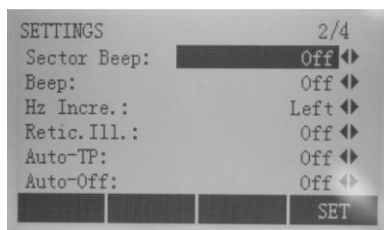
Press left or right direction keys to adjust it.

On: Hz Collimation is switched ON.

Off: Hz Collimation is switched OFF.

If Hz Collimation is On, each measured Hz-angle is corrected (depending on V-angle).

For normal operation the Hz-collimation remains switched on.



### 5.7 Sector Beep

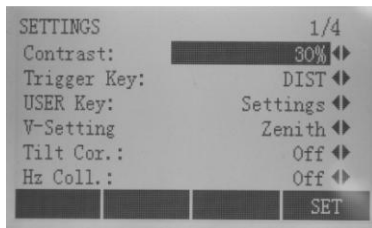
Press left or right direction keys to adjust it.

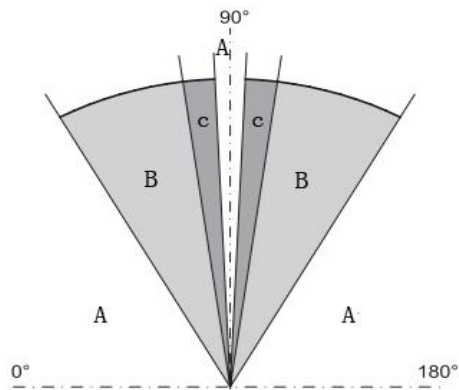
Off: Sector Beep switched off.

On: Sector Beep sounds at right angles (0°, 90°, 180°, 270° or 0, 100, 200, 300 gon)

Example Sector Beep:

From 95.0 to 99.5 gon (or from 105.0 to 100.5 gon) a "Fast beep" sounds while from 99.5 to 99.995 gon (or from 100.5 to 100.005 gon) a "Permanent beep" sounds.





- A: No beep
- B: Fast beep
- C: Permanent beep

### 5.8 Beep

Press left or right direction keys to shift. The beep is an acoustic signal after each key stroke.

Off: Beep switched off

On: Beep switched on

### 5.9 Horizontal Incrementation

Right: Set right Hz for "Clockwise direction measurement".

Left: Set left Hz for "Anti-clockwise direction measurement". "Anti-clockwise" directions are only displayed but saved as "Clockwise direction".

### 5.10 Reticle Illumination

It's possible to set the same reticle illumination as in the above star settings.

### 5.11 Auto-TP (Liquid crystal heating)

On: When LCD heating is switched on, it helps with normal working under cold conditions.

Off: LCD heating is switched off.

### 5.12 Auto-Off

On: The instrument is switched off after 20 minutes without any action.

Off: The instrument is switched on permanently. Battery discharges quicker.

### 5.13 Min. Reading

The displayed angle format can be selected in three steps.

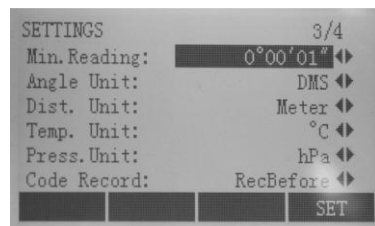
For DMS (DEGREE, MINUTE, SECOND): 0°00'01" / 0°00'05" / 0°00'10"

Always " are indicated.

For DEGREE: 0.0005° / 0.001° / 0.0001°

For GON: 0.0005 gon / 0.001 gon / 0.0001 gon

For MIL: 0.01 mil / 0.05 mil / 0.10 mil





## 5.14 Angle Unit

DMS (degree sexagesimal): possible angle values is 0° to 359°59'59"

DEGREE (degree decimal): possible angle values: 0° to 359.999°

GON: possible angle values: 0 gon to 399.999 gon

MIL: possible angle values: 0 to 6399.99mil

The setting of the angle units can be changed at any time.

The actual corresponding displayed values are converted according to the selected unit.

## 5.15 Distance Unit

Meter: Meter

ft-in1/16: US-feet-Inch-1/16 inch

US-ft: US-feet

INT-ft: International feet

## 5.16 Temperature Unit

°C: Degree Celsius

°F: Degree Fahrenheit

## 5.17 Pressure Unit

Mbar: Millibar

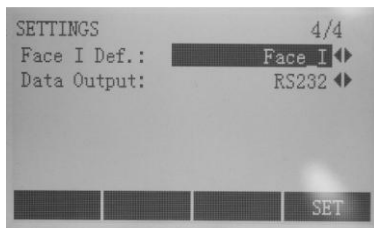
hPa: Hecto Pascal

mmHg: Millimeter mercury column

inHg: Inch mercury column

## 5.18 Code Record

It contains RecBefore and RecAfter here. You can set according to the necessity whether codeblock is saved before or after the measurement.



## 5.19 Face I Definition

Defining the telescope face I means face left. Similarly, defining the telescope face II indicates face right.

## 5.20 Data Output

RS232: Data is recorded via the serial interface. For this purpose, a data storage device must be connected.

Intern: All data is recorded in the internal memory.

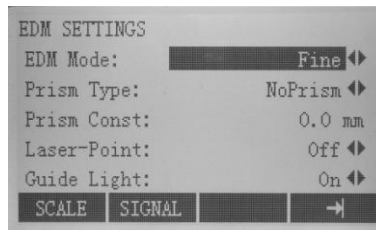
## 5.21 Coordinate Format

You can change the coordinate format of your data being saved on your device using this option providing you with two different types:

1. ENH: (East(x), North(y), Height(z))
2. NEH: (North(y), East(x), Height(z))

## 6 EDM Settings

The EDM settings contain a detailed menu which consists of EDM Mode, Prism Type, Prism Const, Laser-Point and Guide Light.



### 6.1 EDM Mode

The EDM Mode possesses three soNT02 of modes (Quick, Track and Fine) for availability. Worth noting that along with selected measuring mode the selections of prism types are different.

Quick	Quick measuring mode with higher measuring speed and reduced accuracy
Track	Continuous distance measuring
Fine	Fine measuring mode for high precision measurements

### 6.2 Prism Type

Calling the function in the EDM settings.

NERXON Prisms		Constants(mm)
Prism	Circle Prism	0
	MINI	17.2
	JPMINI	34.4
	360°	23.1
	360°Mini	30
	User Define	Self-adjustment
Sheet	Sheet	/

	User Define	/
NoPrism (Reflecto rless)	NoPrism	/
	User Define	/

### 6.3 Prism Constant

Calling the function in the EDM settings. Entry of a user specific prism constant can only be made in User Define mode. Limit value: -999.9 mm to +999.9 mm.

### 6.4 Laser Point

You can aim at your target using the laser point, specifically helpful when you're using NoPrism Target Type.

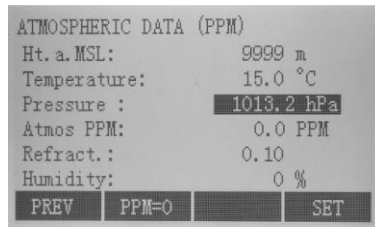
### 6.5 Guide Light

The person at the prism can be guided by the flashing lights directly to the line of sight. The light points are visible up to a distance of 150 meters. This is useful when stake out points.

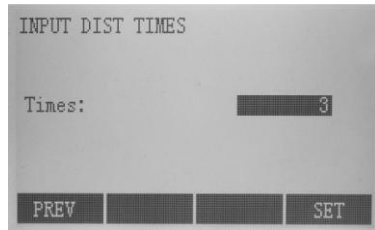
**[ATMOS]:** Input of atmospheric parameters.

Atmospheric Data(ppm): Distance measuring is influenced directly by the atmospheric conditions of the air where distance measuring is carried out.

In order to take into consideration these influences distance measuring is corrected using atmospheric correction parameters.

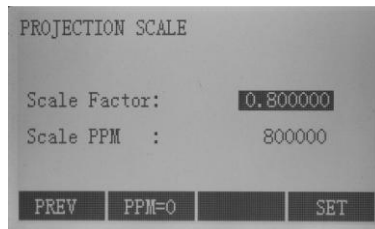


- 1)Ht. a. MSL: Height above sea level at instrument location.
  - 2)Temperature: Air temperature at instrument location.
  - 3)Pressure: Air pressure at instrument location.
  - 4)Atmos PPM: Calculated and indicated atmospheric PPM.
  - 5)Refract: Input of refraction coefficient for the atmospheric conditions. The refraction correction is taken into account in the calculation of the height differences and the horizontal distance.
  - 6)Humidity: Input of atmospheric humidity.
- [TIMES]:** Input of distance measuring times.



**[SCALE]:**Scale of projection.

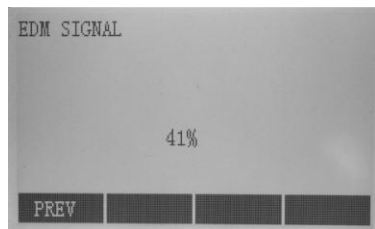
Scale factor: Entering the scale of projection. Measured values and coordinates are corrected with the PPM parameter. Limit value: 0.50 to 1.999999.



PPM: Input of individual scaling parameters.

[PPM=0] Set default parameters.

**[Signal]:**Display EDM signal intensity(reflection intensity) in steps of 1%.Permit optimal aiming at distant barely visible targets.



## 7 File Management (JOB)

The File Manager contains all functions for entering, editing and for checking data in the field.

FILE MANAGEMENT	1/2	FILE MANAGEMENT	2/2
F1 Job	(1)	F1 Initialize Memory	(5)
F2 Fixpoints	(2)	F2 Memory Statistic	(6)
F3 Measurements	(3)	F3 Mem Select	(7)
F4 Codes	(4)	F4 USB	(8)
F1	F2	F3	F4
F1	F2	F3	F4

### 7.1 Job

Jobs are a summary of data of different types, e.g. fixed points, measurements, codes, results, etc. The job definition consists of the input of job name and user. Additionally, the system generates time and date at the time of creation.

```
VIEW JOB 23/23
Job: SHE
Operator: SH
Date: 08.06.2013
Time: 08:52:19
Note 1: -----
Note 2: -----
DELETE ADD ENT
```

#### View Job:



Switch among created jobs.

[DELETE] Delete selected job.

[ADD] Start a new job.

[ENT] Set the selected job.

### 7.2 Fixpoints

Valid fixed points contain at least the PtID and the coordinates (East, North) or (Height).

```
VIEW FIXPOINTS 8/8
Job: SHE
PtID: 6
North : 7.000 m
East : 8.000 m
Height: 9.000 m
FIND DELETE ADD EDIT
```

#### View Fixpoints:

[FIND]: Start point search. Exact PtIDs can be entered or the \* wildcard-criteria used.

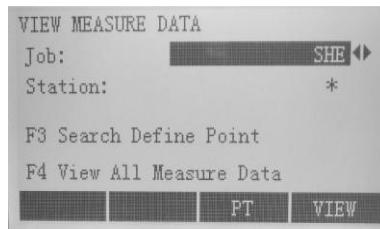
[DELETE]: Delete selected fixed point.

[ADD]: Open input for new PtID and coordinates.

[EDIT]: Edit known data.

### 7.3 Measurements

Measurement data stored in the internal memory can be searched, displayed or erased.



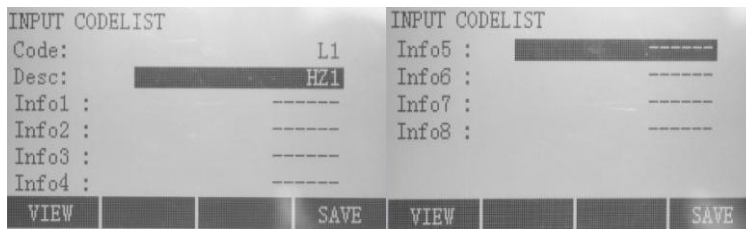
#### View Measure Data:

[PT] Start point search dialogue.

[VIEW] Display all measurements.

### 7.4 Codes

In relation to codelist input, code, corresponding description and its maximum of 8 attributes (Info1 to Info8) with up to 16 characters can be assigned.

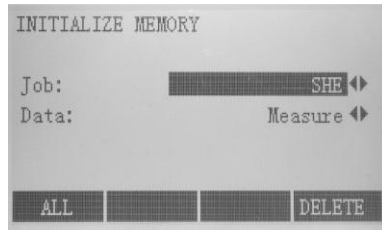


[SAVE] Save data.

[VIEW] Start search dialogue.

### 7.5 Initialize Memory

Delete jobs, single data areas of a job or all data.

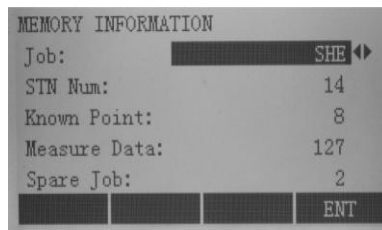


[DELETE]: Start deleting process within the selected area.

[ALL]: Delete all data in memory. All data will be lost!

Deleting the memory can't be undone. After confirming the message all data will be lost permanently.

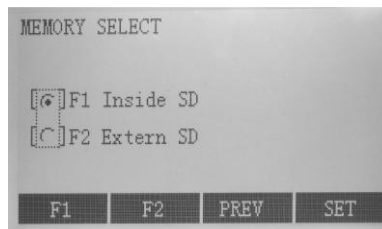
### 7.6 Memory Statistic



Display job's specific memory information such as:

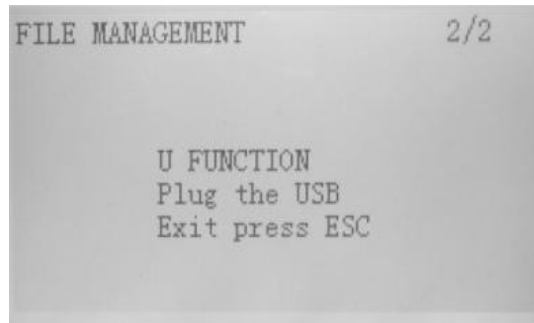
- 1)STN Num: Number of stations
- 2)Known Point: Number of stored known points.
- 3)Measure Data: Number of recorded data blocks (measured points, codes, etc.).
- 4)Spare Job: Number of free or not defined jobs.
- 5)

### 7.7 Memory Select



Provide two methods of memory selecting including Inside SD and Extern SD.

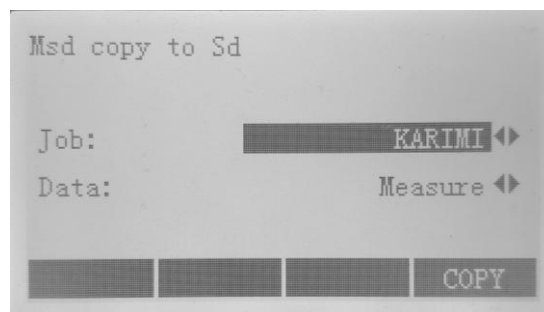
## 7.8 USB



Conveniently, plug flash disk into the USB interface for data sending and selecting.

## 7.9 File Copy

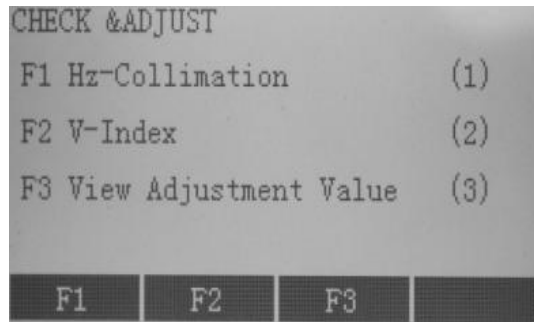
It is possible to copy the job from current internal memory to SD card.





## 8 Check and Adjust

### 8.1 Horizontal Collimation Error and Vertical Index Error



F1: Hz-collimation

F2: V-index

F3: View adjustment value:(Display saved values)

#### 8.1.1 Horizontal Collimation Error C

If the telescope's sight line isn't perpendicular to the horizontal axis, the collimation error will appear. The assembling, transportation and operation will cause this error.

**Note:** After the program correction this deviation error is also on the instrument.

##### 1) Check

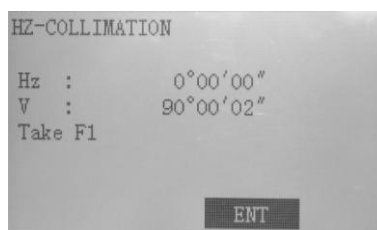
- ① Set-up the instrument on tripod or adjustment platform and leveling accurately.
- ② Aim at the cross-hairs of collimator or the obvious target at a distance. Get the face left angle reading F1 and the face right angle reading F2.
- ③ Calculating the horizontal collimation error C according to  $C = (F1 - F2 \pm 180^\circ) / 2$ , if  $C < 8''$ , no adjustment will be necessary. If  $C > 8''$ , proceed with the following adjustment.

##### 2) Adjustment by program

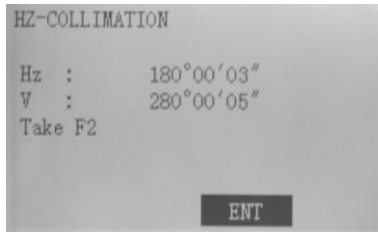
Set up the instrument on tripod or adjustment platform, and leveling accurately.

Procedure:

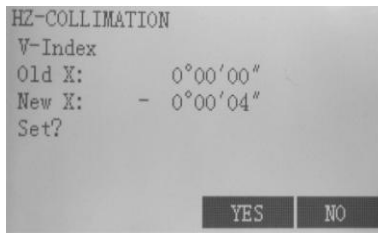
- ① Power on, run the "Hz-Collimation" to access collimation error process.
- ② Aim at the cross-hair of collimator at telescope left, and it'll display the horizontal and vertical angles.



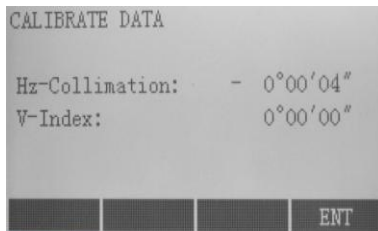
- ③ Aim at the cross-hair of collimator at telescope right, and it'll display the horizontal and vertical angles.



④ The software will calculate the new collimation error and vertical index error automatically.



⑤ Press F3 to view “Calibrate Data”.



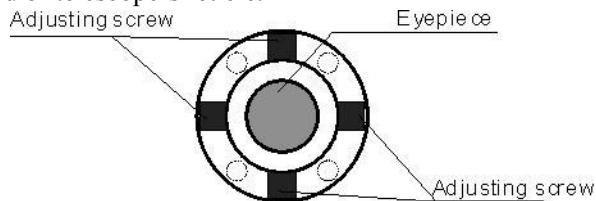
**Note:**

The adjustment can be performed by the program when  $C < 30''$ , if  $C > 30''$ , adjust the reticle.

**Reticle Adjusting:**

① Rotate the instrument in face right position, turning horizontal tangent screw until  $F2' = F2 + C$ .

② Loosen the shield of telescope’s reticle.



③ Adjusting two screws at left and at right until the vertical hairs of telescope’s reticle coincides with the cross-hairs of collimator or target.

④ Repeat the check and adjustment procedure until the error is accepted.

**Note:**

① When adjust the screws of reticle, firstly loosen the screw on the moving direction of

reticle, secondly tighten another screw by the same mount, clockwise turning is for tightening, and anticlockwise turning is for loosening, the turning mount for tightening or loosening should be same.

② After the reticle adjustment, it is necessary to adjust the vertical index error by program.

### **8.1.2 Vertical Index Error**

The deviation between vertical circle zero position and horizontal direction is vertical index (i), it is necessary to concern this error when measure vertical angle. The instrument program applied a formula to remove this error. This correction can offer the index for the formula.

Warning: Before starting this operation, be sure to read manual carefully, otherwise it may cause data faulty.

Because of the close relationship between vertical index and compensator zero position, it is necessary to check and adjust compensator zero position when adjust the vertical circle, the value should be stable when reading.

#### **1) Check**

Please adjust the reticle of telescope and correct the collimation error before this operation.

① Mount the instrument at the tripod or a stable device and level it accurately, then turn on the instrument.

② Aim at the cross-hairs of collimator or the obvious target at a distance, VA should be about  $\pm 10^\circ$ . Read the face left angle F1 and face right angle F2.

③ Calculate the index error according to the formula below:

$$i = (F1 + F2 - 360^\circ) / 2$$

④ If  $I < 10''$ , no adjustment is necessary, or you have to adjust it.

#### **2) Adjustment by program**

Set-up the instrument on tripod or adjustment platform, and leveling accurately.

Procedure:

① Power on, run the “V-Index” to access vertical index error process.

② Aim at the cross-hair of collimator at telescope left, and it'll display the horizontal and vertical angles.

③ Aim at the cross-hair of collimator at telescope right, and it'll display the horizontal and vertical angles.

④ The software will calculate the new collimation error and vertical index error automatically.

⑤ Press F3 to view “Calibrate Data”.

## 8.2 Plate Level and Circular Level

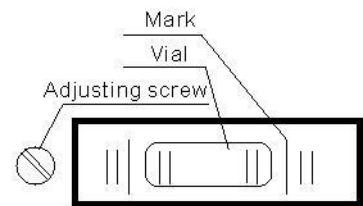
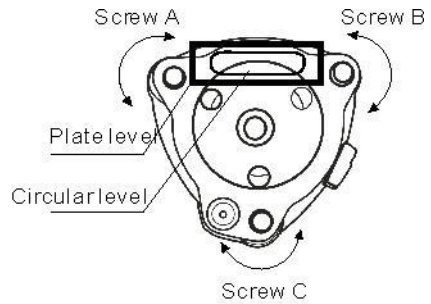
### 8.2.1 Plate Level

#### 1)Check

- ① Mount the instrument on a stable device (as tripod, adjusting device), and fix it.
- ② Level the instrument until the plate level is parallel to a line linking leveling foot screws A and B, then adjust the two screws to center the air bubble.
- ③ Turn the instrument 180°, observe the moving direction of the bubble, if it is still centered, no adjustment is necessary, if not, you have to adjust it.

#### 2)Adjustment

- ① Mount the instrument on a stable device and fix it.
- ② Level it roughly.
- ③ Turn the instrument and make the plate level be parallel to a line linking two leveling foot screws, then adjust the two screws to center the air bubble.
- ④ Turn the instrument 180°, adjust the Adj-screw with adjustment pin slightly to correct half of the bubble's displacement when it doesn't move.
- ⑤ Repeat the operation ③ and ④ until the air bubble remains centered in any position .



Turn the instrument 180°



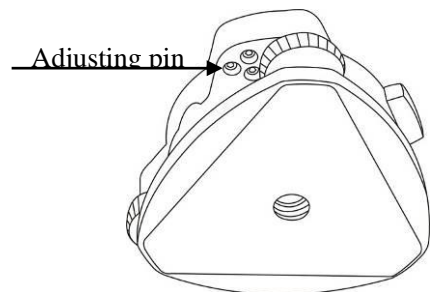
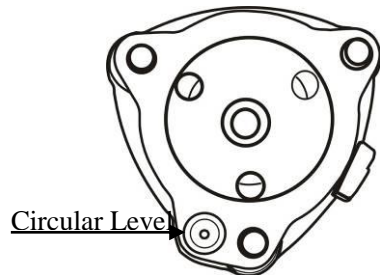
### 8.2.2 Circular Level

#### 1)Check

- ① Mount the instrument on a stable device and fix it.
- ② Level it accurately by the plate level.
- ③ Observe the bubble of the circular level, if it is centered, no adjustment is necessary, if not, you have to adjust it.

#### 2)Adjustment

- ① Mount the instrument on a stable device and fix it.
- ② Level it accurately by the plate level.
- ③ Adjust the three adjusting screws to center the bubble by a wrench.



**Note:** Be careful when adjusting the three screws, and the tightening tension is identical for them.

## 8.3 Optical Plummet and Laser Plummet

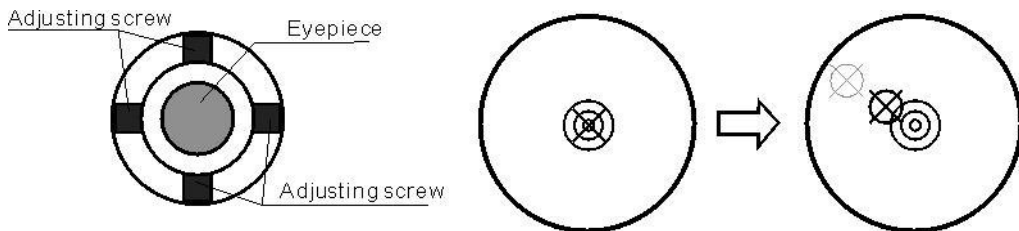
### 8.3.1 Optical Plummet (factory optional)

#### 1) Check

- ① Mount the instrument at the tripod and fix it.
- ② Set a cross mark under the instrument
- ③ Coincide the center mark of the optical plummet with the cross mark by adjusting three leveling foot screws.
- ④ Turn the instrument 180°, check the center mark and cross mark, if they are coincide, no adjustment is necessary, if not, adjust it.

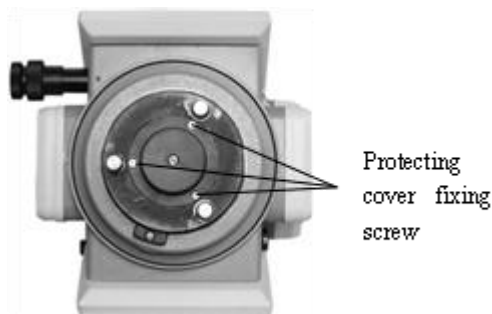
#### 2) Adjustment

- ① Set the instrument on stable device and fix it.
- ② Set a cross mark under the instrument.
- ③ Use the three leveling screws and coincide the center mark of plummet and cross mark on the ground.
- ④ Rotate the instrument 180° around and take off the cover of the optical plummet eyepiece, adjust the four adjusting screws with the adjusting pin to shift the center mark to the cross mark, correct only one-half of the displacement in this manner.
- ⑤ Repeat the operation in ③ and ④ until coincide the center mark of the plummet and cross mark on the ground.



#### Note:

When adjust the screws of plummet reticle, firstly loosen the screw on the moving direction of reticle, secondly tighten another screw by the same mount, clockwise turning is for tightening, and anticlockwise turning is for loosening, the turning mount for tightening or loosening should be same.



### 8.3.2 Laser Plummet

#### 1) Check

- ① Set the instrument on stable device and fix it.
- ② Set a cross mark on the ground under the instrument.
- ③ Turn the laser switch on and focus it

accurately.

④ Turn the three leveling screws until the instrument keeps leveling and the laser spot coincides with the cross mark on the ground.

⑤ Rotate the instrument 180°(200g) around and check the laser spot and cross mark, if they coincide, adjustment is not required. Otherwise, adjust it.

## 2)Adjustment

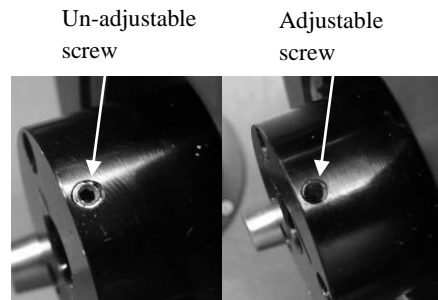
① Setting up the instrument on the checking tool or tripod which is 1.5m apart from ground.

② Turn on laser plummet, turn tribrach foot screws until laser spot coincides with cross mark. If you use tripod, make a cross mark on the laser spot directly.

③ Rotate instrument 180° around, if the laser spot is over 2mm apart from cross mark, remove the protecting cover firstly, adjust two screws with 1.5mm hexagon wrench to move laser spot to the cross mark, correct only one-half of the displacement in this manner. Adjusting details see attached figure.

④ Repeat steps 2 and 3 until laser spot coincides with cross mark always when rotate instrument.

**Note:** There are three screws mounted around laser plummet part, only two screws are used for laser accuracy adjustment.



## 8.4 The Optical Sight

### 1)Check

① Mount the instrument on a tripod and fix it.

② Set a cross mark target which apart from the instrument about 50m.

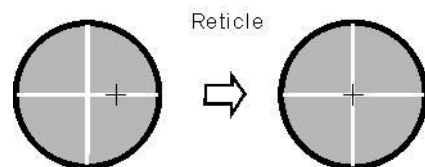
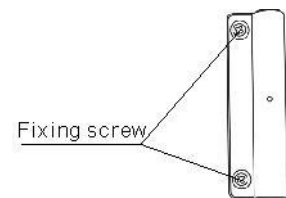
③ Take the telescope sight the cross mark.

④ Observe the optical sight collimator whether collimating the cross mark, if collimate the mark, adjustment is not necessary; if not, adjust it.

### 2) Adjustment

① Mount the instrument at the tripod and fix it.

② Set a cross mark target which apart from the instrument about 50m.

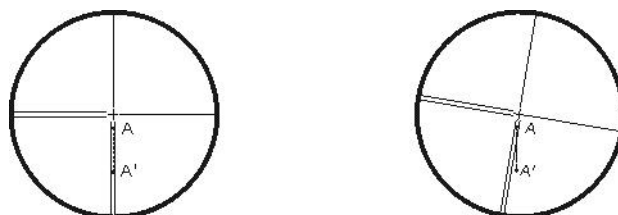


- ③ Take the telescope sight the cross mark.
- ④ Loosen two fixing screws, adjust the collimator, then fix the two screws again.

## 8.5 Vertical Cross-hair on Telescope

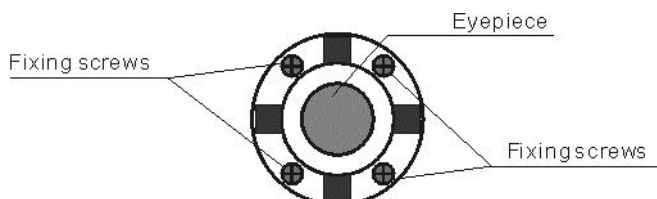
### 1) Check

- ① Set the instrument up the tripod and carefully level it.
- ② Set a point A front the instrument 50m apart;
- ③ Collimate the point A and adjust the vertical tangent screw; If the point appears to move continuously on the hair, adjustment is not required. Otherwise, adjust it.



### 2) Adjustment

- ① Set the instrument, and set the point A front the instrument 50m apart.
- ② Take off cover of telescope eyepiece, there are 4 screws for the reticle part.



- ③ Loosen all four fixing screws slightly with the cross screw-drive.
- ④ Revolve the eyepiece section so that the vertical cross-hair coincides to point A, finally, re-tighten the four screws.
- ⑤ Repeat the checking and adjusting until there is no deviation.

### Note:

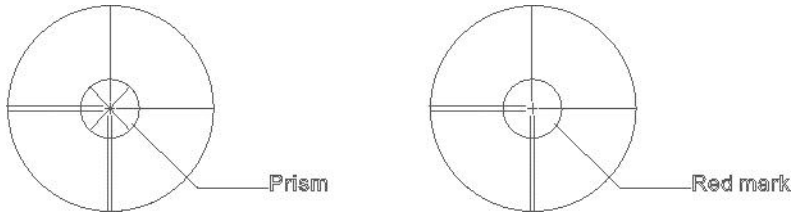
- ① After the adjustment of cross-hair, please check the collimation error and vertical index error.
- ② Refer to the chapter “9.8 EDM Optical Axis and the Telescope Sighting Axis Error” to check the axis. At last check the collimator error again.

## 8.6 EDM Optical Axis and the Telescope Sighting Axis Error

It is necessary to check this error after the adjustment of telescope reticle error.

### 1)Checking

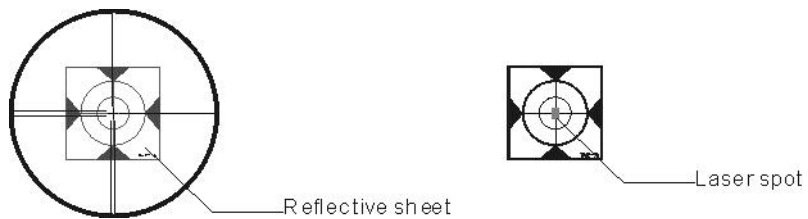
- ① Install the instrument at the tripod or a stable device and level it accurately, then power on the instrument.
- ② Set a prism about 2m far away from the instrument.
- ③ Aim at the prism center with telescope reticle.



- ④ Enter EDM signal testing screen.
- ⑤ Observe through eyepiece, turn the focusing knob until the red mark is clear, if the deviation between mark and cross-hair is not over 1/5 of red mark diameter, adjustment is unnecessary.

### 2)Checking

- ① Install the instrument at the tripod or a stable device and level it accurately, then power on the instrument.
- ② Set a reflective sheet about 5m-20m far away from the instrument.
- ③ Aim at the sheet cross-mark with telescope reticle.



- ④ Enter EDM signal testing screen.
- ⑤ Observe the laser spot, if the laser spot coincides with the cross-mark of reflective sheet, adjustment is unnecessary.

### Note:

Laser radiation, do not stare at laser beam.

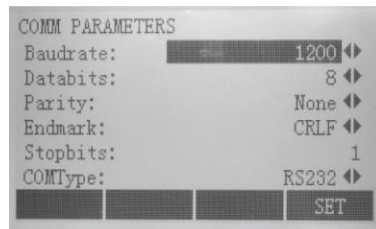
### 3)Adjustment

If the instrument needs adjustment, please contact with our dealers.



## 9 Communicate Parameters

For data transfer between PC and instrument the communication parameters of the serial interface RS232 must be set.



### **Baudrate**

Data transfer speed: 1200, 2400, 4800, 9600, 19200, TOPCON, SOKKIA

(UNIT: [bits / second])

### **Databits**

7: Data transfer is realized with 7 databits. Is set automatically if parity is "Even" or "Odd".

8: Data transfer is realized with 8 databits. Is set automatically if parity is "None".

### **Parity**

Even: Even parity

Odd: Odd parity

None: No parity (if data bit is set to 8)

### **Endmark**

CRLF: Carriage return; line feed

CR: Carriage return

### **Stopbits**

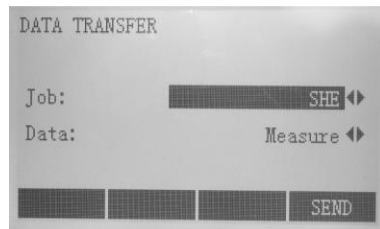
Fixed setting 1.

### **COMType**

RS232 or BLUETOOTH.

## 10 Data Transfer

With the help of this function measured data can be transferred via the serial interface to a receiver (e.g. a laptop).



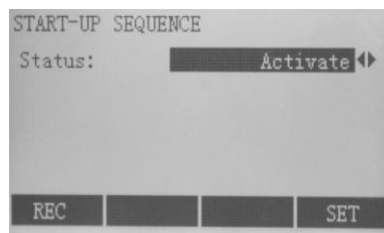
Job: Selection of job from which data should be transferred.

Data: Select the data range to be transferred (measurements, fixed points).

[SEND]: Start transmission.

## 11 Start-up sequence

Start-up screen setting begins when this function status is activated (switched on). E.g. the electronic bubble can be displayed at every start.



[REC]: Give the definition that start-up sequence will be executed automatically on triggering the key.

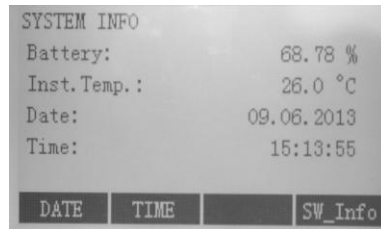
[SET]: Store current settings.

Detailed steps:

After confirming the record boot sequence, the "Meas & Rec" screen is displayed. A maximum of 16 of the next key presses are stored. The sequence is ended with [ESC]. If the start sequence is modified, the stored key presses will be executed automatically when the instrument is switched on.

## 12 System Information

Display helpful information and date / time can be set here.



### 1) Battery

Remaining battery power (e.g. 90.26%).

### 2) Inst. Temp

Measured instrument temperature.

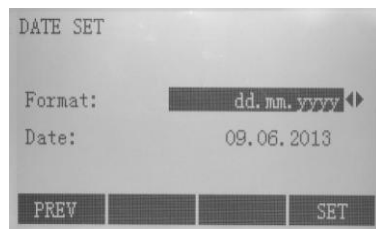
### 3) Date

Show the current date.

### 4) Time

Display current time.

[DATE]: Change date and format.

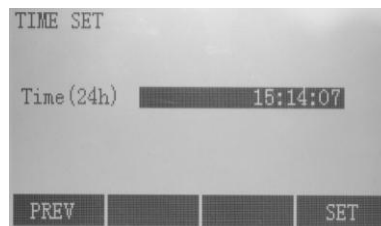


Format: There are three formats:

- DD.MM.YYYY
- MM.DD.YYYY
- YYYY.MM.DD

Date: Input date

[TIME]: Set time.



[SW-Info]



- Display current software version
- Inst.Type indicates specific type of this instrument.

## **13 Instrument Maintenance**

### **13.1 Cleaning and Drying**

- Wipe up painted surface.
- Blow dust off lenses.
- Use only a clean degreasing cotton for cleaning up. If necessary, moisten the cotton with little pure alcohol. Do not use other liquids (oil, gasoline, water, etc) which may attack the polymer components.
- Never touch the glass with your fingers.
- Be careful to wipe damp instrument. Take out the instrument from case and make it completely dry. Do not store the instrument in case. Besides, keep the case clean inside and outside, and keep it dry.

### **13.2 Storage**

When the instrument is stored for a long term, take it out from case in order to allow the air to circulate and avoid lens's mildew. Storage must be under the conditions of dust prevention, air circulation and low humidity. In wet areas use desiccator and fuming cupboard. In cold regions, do not move the instrument indoors during the period of not using it and it's supposed to remain in safe places under ambient temperature, which can prevent water vapor from condensing on optical glasses and inside the instrument.

### **13.3 Transportation**

Put instrument into the case which includes foam in seNT02 or other shockproof stuff for long-distance transportation.

### **13.4 Check**

Better check instrument on a regular basis, and adjust it according to instruction manual if necessary.

## 14 Specifications

### NERXONNT02 PLUS series

#### Telescope

Length	156 mm
Image	Erect
Magnification	30×
Aperture	45 mm
Field of view	1°30'
Minimum focus	1.0 m

#### Angle measurement

Reading system	Absolute encoder
Angle unit	360degree/400gon/6400mil, selectable
Display resolution	1"/5"/10"(or 0.2mgon/1mgon/2mgon)
Accuracy	2"

#### Distance measurement(R500)

Display resolution (m/inch selectable)	0.1mm/1mm
Laser class	Prism Class 1 Reflectorless/Reflective sheet Class 3R
Measurement range (good condition)	Single prism 1 to 3000m Reflective sheet/RP60 1 to 800m Reflectorless 1 to 600m
Accuracy	Prism: 1.5mm+2ppm Reflective sheet/RP60: 3mm+2ppm Reflectorless: 1-200m: 3mm+2ppm ≥200: 5mm+3ppm
Measurement time	Initial: 2s
Prism	typ. 1.0-1.5s
Reflective sheet/RP60	typ. 1.5s
Reflectorless	typ. 1.5-5s, max. 20s

#### Distance measurement(R1000)

Laser class	
Prism standard mode/Prism long mode	Class 1/ Class 2
Reflective sheet	Class 2
Reflectorless standard mode	Class 2
Reflectorless long mode	Class 3R
Measurement range (good condition)	
Standard mode/Prism	1 to 3500m
Long mode/Prism	1 to 6000m

Reflective sheet/RP60	1 to 1200m
Reflectorless	1 to 1000m
Accuracy/typical measuring time(max.20s)	
Prism standard mode:1mm+1.5ppm/1.0s-5.0s	
Prism long mode:2mm+2.5ppm/0.7s-6s	
Reflective sheet/RP60:2mm+2ppm/1s-5s	
Reflectorless:1-500m:2mm+2ppm/0.7s-6s>500m:4mm+2ppm/3s-12s	
<b>Level vial sensitivity</b>	
Plate level	30" / 2 m m
Circular level	8' / 2 m m
<b>Compensation</b>	
Range	± 3'
Resolving power	1"
<b>Optical plummet (Factory optional)</b>	
Accuracy	±0.8mm/1.5m
Image	Erect
Magnification	3×
Focusing range	0.5 m ~ ∞
Field of view	4°
<b>Laser plummet(Standard)</b>	
Accuracy	±1.0mm/1.5m
Laser class	Class 2/IEC60825-1
Laser spot size/brightness	Adjustable
Laser wave length	635nm
<b>Endless drive</b>	H&V
<b>Display</b>	
LCD	Large LCD(240×128dots)
<b>Power</b>	
Battery	3400 mAh Li-ion Rechargeable battery
Voltage	7.4 V DC
Continuous operation time	About 19 hours (single distance measurement every 30 seconds)
Charger	FDJ6-Li (110V to 240V )
Charging time (at +20°C)	Approx. 4 hours
<b>Application programs</b>	
Data collection/Stake out/Resection/REM/MLM/Point to line	
AREA/Z coordinate/OFFset/3D Road	

## Others

CPU	32bit
Memory	128M internal memory, SD card
Guide Light System	Factory optional
Sensors	Built-in temperature and pressure sensors
Keyboard	Alphanumerical illuminated key board, both sides
Temperature input range	-40°C to +60°C
Dimension(W×D×H)	210×210×360m m
Weight (including batteries)	6kg
Dimensions(W×D×H)	185×220×360mm
Interface	USB/RS-232C/Bluetooth(Optional)
Water and dust protection	IP55 (IEC60529)
Data transfer & processing software	NERXON Geomatics Office
Data collector	PS236, fully rugged PDA(Optional)

## 14 Standard components

• Carrying case	1 each
• Instrument	1 each
• Battery	2 each
• Charger	1 each
• Adjusting pins	2 each
• Cleaning cloth	1 each
• Cleaning brush	1 each
• Screwdriver	1 each
• Wrench	2 each
• USB Communication cable	1 each
• Rainproof	1 each
• Reflective sheet/RP30	4 each (Only for NT02 series)
• Reflective sheet/RP60	1 each (Only for NT02 series)
• Laser caution sign board	1 each (Only for NT02 series)



**Appendix I: Atmospheric correction formula and chart (Just for reference)**

Factory setting: temperature: 20°C, pressure: 1013 hpa, 0 ppm (NT02)

temperature: 20°C, pressure: 1013 hpa, 0 ppm (NT02)

The correction:

$$K_{pt} = 274.417 - 0.2905 * p / (1 + 0.0036 * t) \dots \dots \dots \text{NT02}$$

$$K_{pt} = 278.960 - 0.2902 * p / (1 + 0.0036 * t) \dots \dots \dots \text{NT02}$$

Where: p -- Pressure value (hPa)

t -- Temperature value (°C)

K<sub>pt</sub> -- Atmospheric correction (ppm)

Example:

t = 20°C, p = 1013 hpa, L<sub>0</sub> = 1000 m.

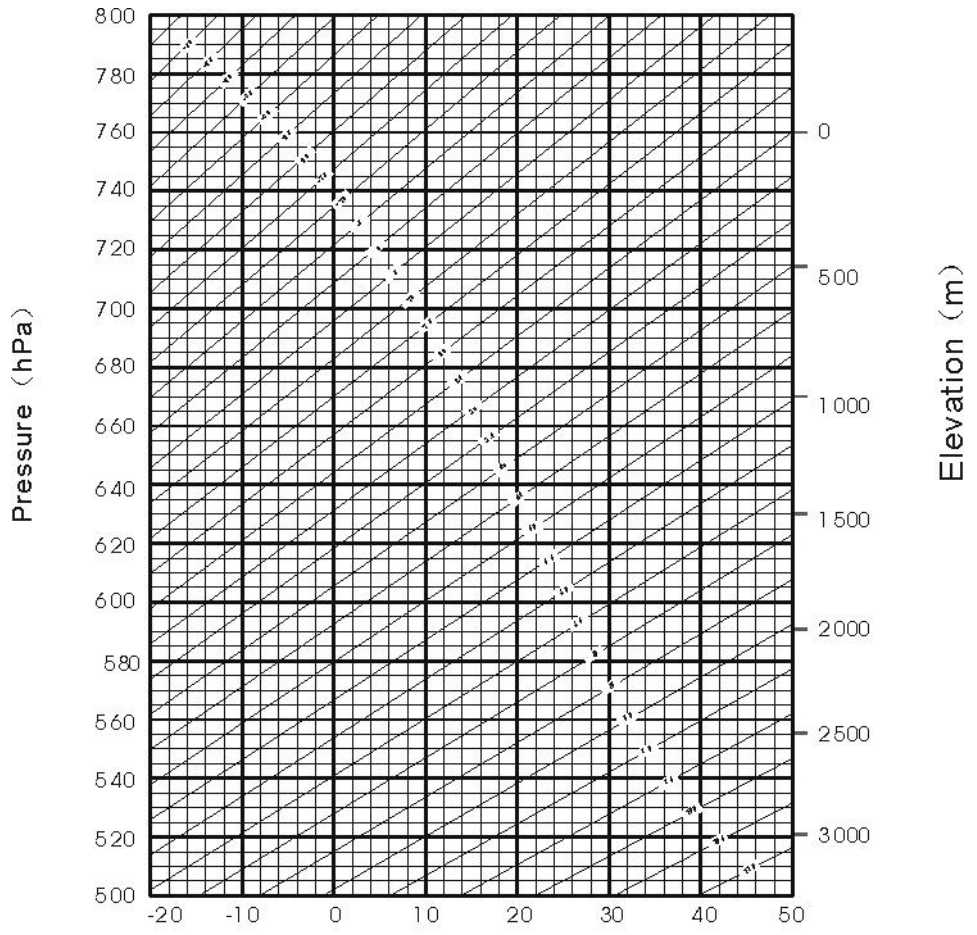
Then: K<sub>pt</sub> = 0 ppm (NT02)              K<sub>pt</sub> = 4 ppm (NT02)

$$L = L_0 (1 + K_{pt}) = 1000 \times (1 + 0 \times 10^{-6}) = 1000.000 \text{ m (NT02)}$$

$$L = L_0 (1 + K_{pt}) = 1000 \times (1 + 4 \times 10^{-6}) = 1000.004 \text{ m (NT02)}$$

The atmospheric value is obtained easily with the atmospheric correction chart. Find the measured temperature in horizontal axis, and pressure in vertical axis on the chart.

Read the value from the diagonal line, which is the required atmospheric correction value.



Temperature (°C)  
For NT02 series

## Appendix II: Correction for refraction and earth curvature

Considering the correction of refraction and earth curvature for distance measurement, the formula for slope distance, horizontal distance and vertical distance applied in the instrument are as followings:

$$SD = D_0 \times (1 + ppm \times 10^{-6}) + mm$$

SD — Displayed slope distance (m)

$D_0$  — Real measured distance (m)

ppm — Scale coefficient (mm/km)

mm — Target constant (mm)

$$HD = Y - A \times X \times Y$$

$$VD = X + B \times Y^2$$

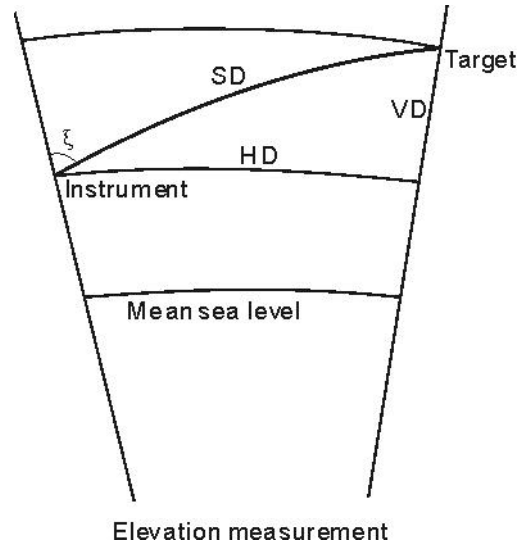
HD — Horizontal distance (mm)

VD — Vertical distance (mm)

$$Y = SD \cdot |\sin \xi|$$

$$X = SD \cdot \cos \xi$$

$\xi$  — Zenith angle



$$A = \frac{1 - \frac{K}{2}}{R}$$

$$B = \frac{1 - \frac{K}{2}}{2R}$$

$$K = 0.142 \text{ or } 0.20$$

$$R = 6.37 \times 10^6 \text{ (m)}$$

The conversion formula for horizontal and vertical distance is as follows when correction for refraction and earth curvature is not applied:

$$HD = SD \cos \xi$$

$$VD = SD \sin \xi$$

**Note:**

The factory setting for the refraction coefficient K is 0.142.

Refer to the section 3.10 to change the value of K.

### Appendix III: Assembling and disassembling for three-jaw tribrach

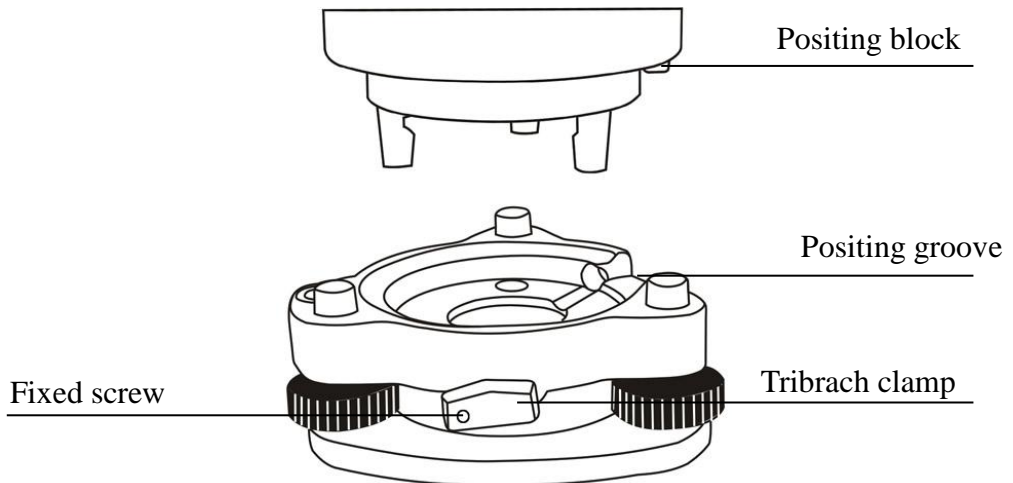
It is convenient to assemble or disassemble the instrument from tribrach by loosen or tighten the tribrach clamp.

#### Disassemble

- (1) Rotate the tribrach clamp anticlockwise until the lever is loosen.
- (2) One hand hold up the tribrach, another hand hold the carry handle of the instrument and lift out the instrument from the tribrach.

#### Assemble

- (1) Put the instrument into the tribrach lightly, let the communication port against in the indentation of the tribrach.
- (2) Rotate the tribrach clamp clockwise until the lever is tighten.



#### Note: Fix the tribrach clamp

If the instrument don't need assembly or disassembly from tribrach frequently, it is necessary to fix the tribrach clamp by fixed screw to avoid the disassembly by accident.

Screw out the fixed screw by driver to fix the clamp.

**NOTE:**

These designs, figures and specifications are subject to change without notice. We shall not be held liable for damages resulting from errors in this instruction manual.